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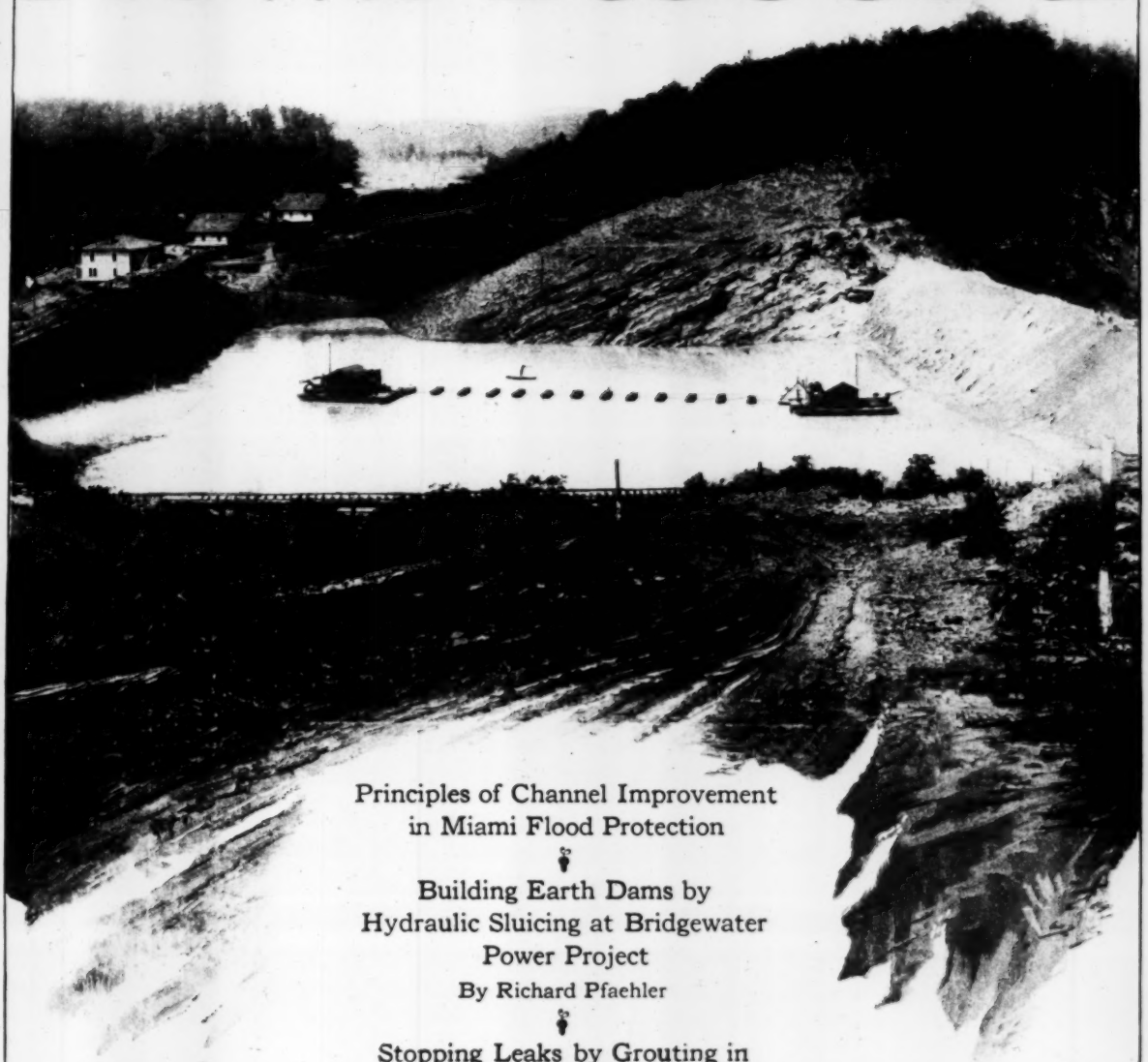

Principles of Channel Improvement in Miami Flood Protection

Building Earth Dams by Hydraulic Sluicing at Bridgewater Power Project

By Richard Pfaehler

Stopping Leaks by Grouting in New York Subway Stations

By M. H. Freeman

Notes on the Road System of France

By E. J. Mehren

Editor of Engineering News-Record

Cover Illustration: Earth Sluicing at Linville Dam of Bridgewater Power Project

Federal Cement Tile Withstands The Acid Test

Detroit Pressed Steel Co.

MANUFACTURERS OF
AUTOMOBILE FRAMES
STEEL STAMPINGS

PHONE RIDGE 4100

1800 MT ELLIOTT AVENUE
Detroit

May 15th, 1919.

Federal Cement Tile Company,

Chicago, Illinois.

Gentlemen:

We have, this day, tested two of your Standard Red Pitched tiles which were taken from our Pickling Building, which has been in continuous service. One tile bore the date of May 5th, 1915, and was coated on the underside with asphalt paint. The other was dated August 10th, 1917, which was an addition to the Pickling Building and was not painted on the underside.

The first tile broke under a uniformly distributed load of 3800 pounds and the second one at 3900 pounds. We found the reinforced metal clean and bright in every respect after the tiles were broken into many pieces.

The concrete was aged in good condition and we were pleased to learn that the carrying capacity of the slab had increased about seventy percent over tiles 30 days old.

Trusting this will be of service to you, we remain

Yours very truly,

DETROIT PRESSED STEEL CO.

John M. Bischoff

Construction Engineer.

JMB-FT

Another Example of Federal Roof Permanence

Acid fumes in the Pickling Room of the Detroit Pressed Steel Company have eaten their way into the underlying steel work, but the Federal Cement Tile in the roof are stronger than the day they were installed as stated in the accompanying letter. This is merely an added proof of Federal Indestructibility under unusually severe conditions.

Make your new roof *proof against fire, weather acid fumes and age.*

"The Indestructible Roof"

FOR FLAT and PITCHED SURFACES

Made, Laid and Guaranteed by

FEDERAL CEMENT TILE COMPANY

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, AUGUST 12, 1920 — Number 7

How To Buy a Railroad

IN ITS latest monthly bulletin the National City Bank of New York suggests to railway employees how they may gain their desired control of or at least a voice in the management of the railways. It says: "The railroad wage bill after the new wage scale goes into effect will be about $3,600,000,000 per year, and if the employees would set aside 5 per cent they could begin to accumulate an interest in the railroads at the rate of $180,000,000 per year. If this was applied to the purchase of stock rather than bonds they would come quite rapidly into an influential position in the control of the roads, particularly if they concentrated their purchases upon certain systems. The New York Central system has $222,729,300 of stock outstanding, now selling in the market at about $70 per share, or at a valuation of $155,950,510 for the entire stock. A majority would give control and even a respectable minority interest would give representation." Here is a chance for Mr. Plumb to do some constructive organizing.

Construction Machinery in Europe

STRUCTURAL conditions in Europe before the World War were radically different from those in this country. There labor was plentiful and cheap, material was scarce and costly. Here we had plenty of material at a reasonable cost, but labor, though plentiful enough generally, was expensive. Designing, therefore, on the two sides of the ocean was on a different basis, for the European engineer could go to extremes unknown here to save material, regardless of the amount of labor such construction required. This is all changed now in Europe, for though material is as scarce and high as ever labor is demanding and getting higher pay, pay almost as high, in fact, as that now prevalent here. One immediate consequence of this is an influx to this country of visiting foreign engineers, all intent on studying our methods of construction, and particularly of inspecting our construction machinery. Plant in Europe is to mean more than anything else in future construction operations, and these men will have to know how it is to be provided and how to adjust their methods to its use. Making due allowances, therefore, for habit and precedent, we should see soon a greater uniformity of engineering practice on the two sides of the Atlantic. Even though financial conditions are adverse, this should afford an exceptional opportunity for American makers of construction machinery.

Flat-Slab Moment Coefficients

REINFORCED-CONCRETE flat-slab design is notably indeterminate. The theory is anything but exact and tests are not sufficiently numerous or in agreement to confirm any one method of computation. In general, though, such design is becoming standardized, the variations being practically confined to different moment coefficients. These differences, however, are quite marked, as the tabulation of the coefficients on p. 300 shows. Here surely is work for a standardization body such as the Joint Committee on Concrete. With evidence as to the exact numerical values so lacking the authority of this committee should be great enough to popularize its coefficients in the various big centers of the country, so that the somewhat ridiculous variations shown would be minimized if not entirely removed. While no one can claim that any particular coefficient is correct, certainly there is no excuse for half a dozen values for the same things. After the Joint Committee establishes values in its forthcoming new report it should do a little missionary or publicity work in defense of its standard.

Mobile Alley Paving Plants

AMONG paving operations of all kinds the last to be considered susceptible to improvement by machine methods is paving city alleys with concrete. As alley paving is usually planned the yardage of any one operation is small, the operations are scattered and plant room is restricted. Hand mixing persisted for a longer time in alley paving than in street paving and road construction. When finally the concrete mixer replaced the mixing board it was not until quite recently that the mehcanically charging and distributing paving mixer was commonly employed. Even now there are few alley paving operations in which all tasks, not accomplished by the mixer itself, are not manual processes carried out with hand tools. The example, therefore, in our issue of Aug. 5, p. 283, of alley paving operations in which all processes are about as nearly as possible a hundred per cent mechanical, suggests inquiry beyond the fact of a 40 per cent increased output obtained. What machine quality is responsible for the success of the experience described? Obviously it is the quality of mobility. Every unit of the equipment (loaders, truck-tractors, mixer) can either travel by its own power or can be hooked up and hauled from one operation to the next. The whole outfit is as quickly made ready to move and will travel as fast as an equipment of small mixer, wheelbarrows and carts.

Patience and Waterproofing

PATIENCE and persistence play a larger part in successful engineering than the textbooks teach. Every operation that contains new elements requires, in some measure, a working forward step by step, a trial-and-test procedure. The successful work is that in which the trial is most patient and the test study most searching. In the excellently performed grouting operations at Canal Street station, described on p. 314 by the engineer who put the work through, patient persistence found its reward of success. This phase of the matter merits as much attention as the technical points

involved. At the start the station had a hopeless appearance—passengers who had to use it daily said it leaked like a sieve. And only the most persevering step-by-step experimentation proved the truth of what some asserted from the beginning, namely, that the leakage was not general but was largely localized at a few points. That the task of restoring the water-invaded station was so tedious and problematical lays insistent emphasis also on the importance of carrying out waterproofing with full provision for settlement or other change that may vitiate its integrity. Leakage developing in any important structure located below groundwater level is so troublesome that no cost and difficulty are too great in making the details of the waterproofing permanently secure at the start.

Federation Calls for Charter Members

LAST week the Joint Conference Committee, representing the four founder societies of civil, electrical, mechanical and mining engineers, sent to a long list of national, state and regional organizations a formal invitation to become charter members of the Federated American Engineering Societies, for which a constitution and by-laws were approved by delegates to the organizing conference held in Washington, D. C., in June. The invitation is reprinted in the news columns of this issue. Summer is always a period of comparative inactivity in engineering society affairs and it is not to be expected that the machinery of the federation will begin to function until November, when, it is announced, the first meeting of the American Engineering Council, constituting the directorate of the federated societies, will take place. The time is now here, however, for societies to reach a decision regarding their own participation in the federation movement. Some engineers are frankly opposed to the plan, many others see in it a great opportunity for uniting a profession, split up into groups of specialists, and giving to it the influence which always goes with a big membership and without which, especially in matters where legislation is concerned, any particular group is almost impotent in securing a hearing, to say nothing of getting favorable action on measures under consideration. The engineering societies of the country now have the issue of the federation squarely before them, and with the constitution of the new organization printed and distributed widely there should remain no doubt as to just what obligations and advantages the movement for a unification of the engineering profession involves. The decision of national and local bodies should be made promptly, for November is not far away, and it is highly desirable that the first meeting of the federation's council should have a large and thoroughly representative attendance.

A New Opening for Engineers

MUNICIPAL engineers have always done more or less city planning, but along the narrow lines of one element of the city plan. Even at that the planning has generally been fragmentary, both geographically and as regards the future. Rarely has there been any serious attempt to correlate two elements of the city plan; almost never all of them. Blame for this rests far more with the city councils and citizens than with the engineers, but if the latter had only had more vision, foresight and initiative than they have yet shown the importance of broad city planning would have been recognized by city councils and people and the engine would have been authorized—yes, instructed—to ahead long before this. Fortunately a marked cha is taking place. City planning is now widely accep in theory and is being established in practice. It d not originate, as it should have done, with engine though a few have taken a leading part in it. N that the movement is getting beyond the mere edu tional and promotional stage engineers are be drafted into the service—as yet more commonly minor though fairly important positions, but sometim at the forefront of the executive staff. The numbe and dignity of these city planning positions for engi neers promises to grow rapidly. Wide awake engineer with even latent capabilities in the city planning field will be on the lookout for these new openings. They afford great opportunities for service and, like othe work in comparatively new fields, warrant compensation above the average. But even if it yields no extra financial reward, city planning is an attractive field.

Restoration of French Roads

WHILE Mr. Mehren's notes on the highway system of France on p. 303 of this issue contain no sweeping generalization which forecasts the passing of the waterbound macadam road, evidence is presented to indicate that at least in the repair of the main national routes former standards of practice will be altered to meet the demands of an increased amount of motor traffic. In the plans for rehabilitating the principal thoroughfares after their period of severe war service it appears that the new types of surfacing will take the form of ashpaltic macadam, sheet asphalt and stone block. Concrete roads, apparently, will play a negligible part in the work of restoration, nor will concrete foundations for other types of wearing surface be so much in evidence as they are in the United States, for the French macadam roads, superbly drained and substantially built, will form an adequate foundation for new work. To those familiar with the conservatism of French practice this news is not unexpected. Tradition means much more over there than it does with us and radical departures from precedent are made, if at all, only after great deliberation. It appears, however, that experimental sections of concrete pavement are to be laid, but among French engineers it is felt that a concrete road through a rural district where a considerable amount of horse-drawn traffic continues would raise decided protest on the part of the great middle class engaged in the production of food products and wine. American engineers will find illuminating the figures which Mr. Mehren presents on the maintenance costs of waterbound macadam under traffic conditions very much less severe than those of our heavily traveled interurban routes. France's road problem is different from our own in many of its principal aspects, but a fundamental lesson—that of adequate drainage—is the one which American engineers should take to heart. It is not a case of our being ignorant of the best methods of road drainage, but rather of our neglect, oftentimes, to do what we know should be done. Mr. Mehren has presented the case so succintly that his words may well be repeated: "The only point to be emphasized is that they have actually applied these [drainage] methods. They have not merely considered them beautiful theories."

City Cleansing at Philadelphia

CITY cleansing is a term long used in Great Britain to designate all those activities that we in this country more cumbersomely express as street cleaning and the collection and disposal of garbage, ashes, and other city refuse. This very precise British term, though not used in America, might well be applied in a double sense to the subject which is now uppermost at Philadelphia. We say this because that city, after a long and seemingly inexcusable delay in meeting a mandate of the new city charter, stated further on, is now advertising for proposals for street cleaning and the collection and disposal of garbage, ashes, and rubbish, and also because upon the solution of the physical cleansing problem depends in large degree the success or failure of Philadelphia's most recent attempt in political cleansing.

Although most of the complicated details of the Philadelphia city cleansing situation are chiefly of local interest some of the main points at issue are of wide general concern. These include such evils as a contract system skillfully designed to favor unholy alliances between contractors and political bosses (factional instead of rival political bosses in Philadelphia) and to shut out almost absolutely any and all competition from contractors in other cities.

The controlling factor in the Philadelphia situation heretofore, but now possible of elimination—and that is where political cleansing is at issue—has been the letting of contracts for the absurdly short term of a year. To clinch the certaintly of throwing the Philadelphia city cleansing contracts into the laps of the factional political contractors in favor at the moment the common practice has been to withhold the advertisements for bids until a very short time before the contracts were to go into effect. Both the one-year contracts and the delay in advertising for bids have mattered less for street cleaning, and for the collection of garbage and other sorts of refuse, than for the disposal of garbage. The reason for this difference is that although capital investment for street cleaning and for the collection of various classes of refuse is large for a city the size of Philadelphia, yet a considerable portion of the equipment can be turned to other uses if a contract is not renewed, whereas the garbage disposal plant involves a heavy investment for special apparatus that can be used for nothing else.

A feature of the new charter that is directly pertinent to the present discussion, and that doubtless contributed materially to the election of the "reform administration" that took office last January, was specially designed to do away with the political contracting evils allied with city cleansing in Philadelphia. This portion of the charter made it compulsory for the city to clean its streets and collect and dispose of its garbage, ashes, and other refuse by its own forces instead of by contract, beginning Jan. 1, 1921, *unless* the mayor and a majority of the new and relatively small city council decide to continue to have the work done by contract. In case it was decided to continue contract work the new charter provided that before Aug. 1 bids for doing the work by contract might be invited. Although it was obvious that if a change from contract to direct municipal work were to be made there was no time to be lost in preparation for it the new administration was very dilatory in starting the necessary action. When the report on the subject was made a few weeks ago by three engineer-officials of the city it was unanimously in favor of the work being done by the city instead of by contract, with the exception that one of the three investigators advised that because of the magnitude of the changes involved a portion of the work should continue to be done by contract during 1921.

Judging from reports which come from Philadelphia it appears that much apprehension exists lest the main object of the present city administration should not be so much to free itself of the evils of political contractors as to throw the contracts from one local faction to another. This may be unjust, but if so it is the sort of injustice or misapprehension that must be suffered in a city where maladministration of municipal government has long been the rule and where due diligence and unmistakable intent to bring about reforms have not yet been shown by the new administration.

As to the specifications themselves, they are too detailed, present too many plans and combinations of plans and alternatives, and also are too local in character to warrant an attempt at analysis except by those who intend to bid—and we predict that few, if any, contractors outside of Philadelphia will be so venturesome. With the exception of an alternative of a five-year instead of a one-year contract for garbage disposal alone and the further exception that proposals are asked for the sale of old and of new street cleaning and collection equipment to the city the proposed new contracts are all for a single year. Philadelphia stands alone among the larger cities of the country in having its street cleaning done by contract. This work, as well as the collection of garbage and refuse, should be done by the city direct, or else, if by contract, under specifications and city inspection of a different sort than usually prevail in Philadelphia. As to the disposal of garbage, a one-year contract is a farce and a five-year contract is too short. The alternative for garbage disposal, at least, and probably for all the other work, should be either direct municipal work or else contracts of sufficient length to get back the money on the investment without unduly high prices on the one hand or a political gamble on the renewal of the contract on the other—most likely something of both.

It is only fair to say that the city cleansing situation at Philadelphia presents many difficult problems. They have been made harder by delay and apparent indecision. Some, but not all, would be eliminated by a change from contract to city service. In any case, a strong engineering staff needs to be provided in the Bureau of Street Cleaning—a fact recognized and emphasized by all three of the engineers in the report already mentioned.

Difficult as the Philadelphia city cleansing problem is, both physical and administrative, it can doubtless be solved in a satisfactory manner—due allowances being made for the inheritance of past evils and for dilatoriness—if it is handled in a businesslike engineering way. There are plenty of engineers connected with the city administration of Philadelphia who could bring order and efficient service into municipal cleansing in Philadelphia if they were given free hands and wholehearted backing. We do not mean to say that this is not the intent of the administration, nor that the bids now being asked may not be used as a step to that end, but in this respect the administration is on trial not only before Philadelphians but the rest of the country as well.

Principles of Channel Improvement in Miami Valley Flood Protection

Flow Capacity of River Increased to Supplement Action of Detention Basins—Bottom of Enlarged Channel Shaped for Low-Water Flow—Scour Protection by Concrete Revetment, Block Mattresses and Sills

NEARLY one-third of the cost of the $25,000,000 flood-protection works of the Miami Conservancy District in southwestern Ohio, is being spent on channel improvement. Though the project is commonly regarded as a detention-basin system, the channel work is a vital element of the protection to be given the industrial cities in the valley of the Miami, since the throttling action of the five great detention dams will not suffice to bring the maximum flood flow within the capacity of the river as it existed hitherto. Careful engineering study of river action, and designs adjusted to the results of this study, were involved in the planning of the channel work. From the review of the main elements of the planning given by the present article it will be seen that the final plans for the work represent a narrowly limited solution of a problem defined by the physical and topographic conditions existing in the valley.

FIGS. 1 AND 2. VIEW AT JUNCTION OF MIAMI AND MAD RIVERS, DAYTON, LOOKING DOWN MIAMI FROM HERMAN AVENUE BRIDGE; WEBSTER AVENUE BRIDGE OVER MAD RIVER AT EXTREME LEFT

Upper picture: Before improvement, view taken May 21, 1918. Lower picture: Condition on June 24, 1920; new levee in foreground at right is up to full height, but short bank between it and old levee is still to be filled.

At Dayton and Hamilton, the two key points of the flood protection territory, the channel of the Great Miami River has a bank-full capacity (prior to the present improvement) of 90,000 and 100,000 sec.-ft. respectively. The peak flow of the 1913 flood, the disaster which led to the formation of the Miami Conservancy District, was 250,000 and 350,000 sec.-ft. at the two cities. Fifteen years before, in the 1898 flood, a peak flow of 90,000 and 110,000 sec.-ft. was reached, which did much damage and led to costly levee-raising work at Dayton. Statistical studies made by the Morgan Engineering Co. just after the 1913 flood pointed to the conclusion, reached late in 1913, that a storm might at some future time occur which would produce a maximum flow (if unregulated) of 350,000 and 490,000 sec.-ft. at the two cities in question. The "maximum flood" will be controlled by the detention basins, but will still have a volume of 125,000 sec.-ft. at Dayton and 200,000 sec.-ft. at Hamilton, which considerably exceeds the present capacity between levees.

Economic Balance of Channel and Basin Work—Complete flood-protection could have been secured by either detention basin alone or by channel improvement alone, but at a cost that would have made the work impossible; a low-cost solution was found by combining the two.

The available reservoir sites were limited in number, partly by topographical and subsoil conditions, and partly by the distribution of population in the valley, the latter factor also limiting the storage height in some of the reservoirs actually adopted. Due to these and other reasons, while it would have been possible to provide basin storage (or detention) sufficiently great to reduce the river flow to the channel capacity, a much increased expense, and above all a serious disturbance of conditions in the valley, would have been involved. Such protection by detention basins alone would have cost $93,000,000.

Protection by channel enlargement alone would have required radical changes in the cities, since a flow volume fully three times the present channel capacity would have had to be provided for. The cost of such improvement has never been accurately computed, but rough estimates made five years ago showed that it would exceed $150,000,000. On the other hand, it was found that a group of detention basins capable of dealing with roughly two-thirds of the maximum flood volume could be built for about $15,000,000, and the river channel could be enlarged through the cities to accommodate one-third the unregulated flow at a cost of about $7,000,000, thus giving complete protection at a total cost (land and engineering included) of about $25,000,000. The figures quoted are strictly comparable, being based on pre-war costs, but they would of course stand proportionately higher today.

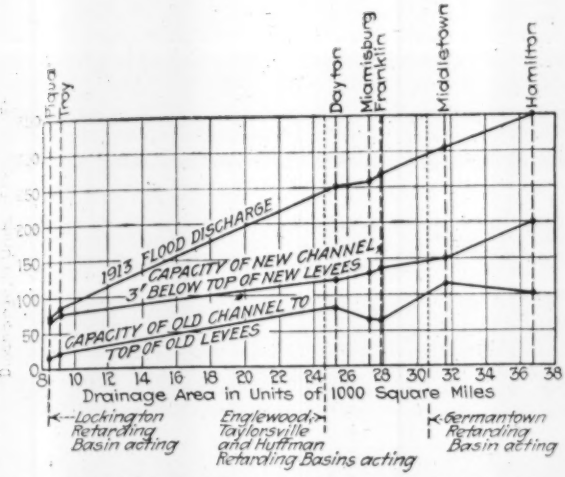


FIG. 3. FLOOD FLOW AND CHANNEL CAPACITY OF MIAMI RIVER

The great difference between the cost of the combination project and the cost of either pure basin or pure channel control is due to the topography of the valley and the distribution of population and improvements. Their effect is to make both reservoir construction and channel enlargement run up in cost at abnormally rapid rate beyond a certain capacity limit. The successful planning of the present enterprise depended essentially on finding out the economic limits of both channel improvement and basin work, and combining the two resources for the joint solution.

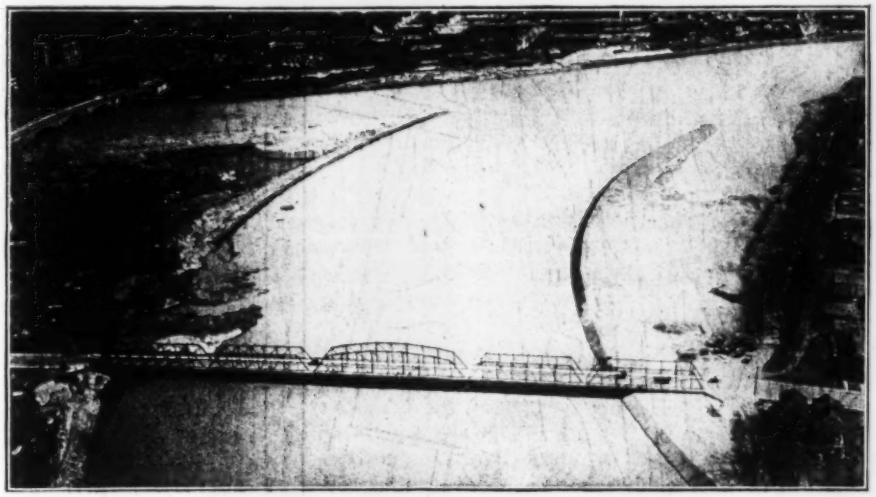


FIG. 4. AIRPLANE VIEW OF IMPROVED MAD-MIAMI JUNCTION IN A RECENT FRESHET

Limits of Channel Enlargement—Excavation is relatively cheap when confined to the natural width of the stream, where unencumbered by encroachments, but the cost suddenly rises when the widening is carried so far that streets and other city work and structures are encountered. Increase of depth, on the other hand, is limited in part by the channel slope, in so far as this leads to the necessity for extending the excavation downstream of the improvement section if the natural bed profile is lowered too much.

Scour effects also are involved in channel enlargement. The average slope of the Miami River, 3½ ft. per mile, is in itself quite steep, so that the high-water velocities are large. In its condition as found, the river was stable as to scour, but since it had formed its own bed the equilibrium was likely to be disturbed by the higher velocities necessarily resulting from improvement. These facts influenced the detail design of the channel work as noted farther on. With respect to the general planning their primary importance was to limit downward deepening of the channel to a minimum; as the river bed consisted of the larger gravel of the subsoil, selected and sorted by the action of the river, excavation below the natural bed would be likely to expose more vulnerable soil and thus initiate scour and instability of channel.

Increase of channel depth by raising the levees was subject to limitations not only as regards interference with city structures, but also as regards popular apprehension likely to be aroused by high levees. Topographic conditions, moreover, made it necessary to consider long section of river as units with respect to leveeing.

The two largest cities in the valley, Hamilton and Dayton, presented quite different channel-improvement conditions. With a normal flood flow 50 per cent greater than that at Dayton, Hamilton had a channel actually narrower in its most constricted sections than Dayton; encroachments had brought the minimum river width at Hamilton down to 390 ft., as against a 550-ft. minimum width (between levees) at Dayton. On account of the naturally deep channel, due to high banks, at Hamilton, there were no levees through the city except in one or two individual sections, and the adjustment of the city to this condition tended to prohibit extensive levee construction as part of the improvement. Generally the flood exposure of Hamilton was considerably more serious than that of Dayton, and the destruction done in the 1913 flood was comparatively greater. Thus a decision in the matter of balance between channel improvement and basin construction could not be reached from a study of the limitations prevailing in one city alone but had to consider other cities; and where a basin location existed between two given points along the river, the planning of channel improvement for the lower point had to be considered separately in conjunction with this basin, as well as in its relation to the entire flood protection system.

Local conditions were fully as individual at the other communities along the river (Piqua, Troy, Miamisburg, Middletown and others) as at Hamilton and Dayton, but the two latter cities were the key points with respect to the planning of the system as a whole, due to the decisive limitations they placed on increase of channel capacity. For the other cities the local conditions controlled the planning of the local protection in detail, but were of quite minor influence in determining the economic extent of regulation by detention basins.

A limiting factor not mentioned above was found in

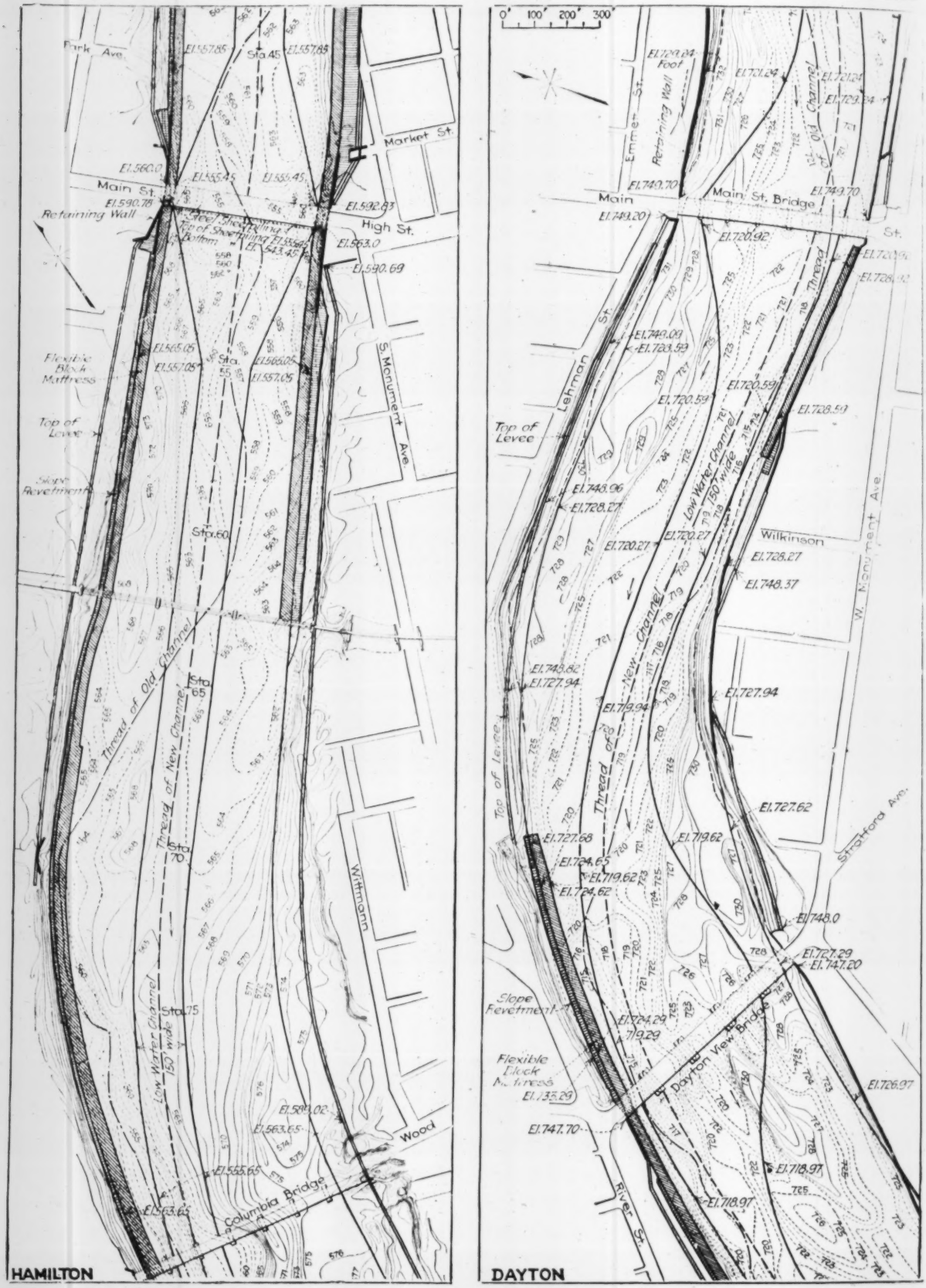


FIG. 5. PORTIONS OF MIAMI CHANNEL IN HAMILTON AND DAYTON, SHOWING ADJUSTMENT OF IMPROVEMENT TO PRIOR CONDITIONS

(Dot-and-dash line marks thread of old channel; dotted line marks thread of new channel.)

bridges crossing the river. Dayton had a large number of street bridges, most of them of the reinforced-concrete arch type. Their elevation was such that the levee heights could be increased at most by 2 or 3 ft., unless the bridges were to be taken down and rebuilt. Further, no material deepening of the channel was practicable unless the bridge piers were underpinned, as their foundations in most instances were shallow. Consideration of these matters resulted in making the solution for Dayton a combination of widening, deepening, and levee raising, in each case carried practically to the point where further enlargement would have meant an abrupt rise in the cost. At Hamilton, however, bridges were not determinative to the same extent. There was only one street bridge left after the 1913 flood, though this was rather short and of low elevation, and only one railroad bridge. Because of the narrowness of the channel, however, and the existence of many encroachments, the major part of the improvement here necessarily consisted of widening.

The final result of the trial design is expressed in the diagram of river flow, Fig. 3, which gives channel capacities and 1913 flood flow. Briefly, the channel enlargement at Dayton and Hamilton represents an increase of 25 to 80 per cent over the channel capacities existing in 1913; at a number of the other cities, notably those above the Taylorsville basin, the capacity inside the new levees represents a much larger increase over the old channel capacity, as the effect of basin regulation is less at these cities.

Channel Cross-Section—The old levees generally had water-side slopes of 2:1, although some slopes were found that were even steeper than 1½:1. The old bottom consisted of gravel banks irregularly distributed, generally with a main channel located along the outside of the curves. The irregularity of the bottom and the existence of pools and minor channels of flow created undesirable conditions at all stages, flood flow being held back unnecessarily by the excessive roughness of the bottom, while during the low-water periods stagnant pools were present. The Miami River has a very low ratio of minimum to maximum; in fact at many points this ratio is zero, since hydraulic canals take the full dry-weather flow. There was in general no possibility of maintaining a definite minimum stage, or even a water flow, without ponding by dams, which was not considered favorable to free discharge of flood flow, or worth the cost.

To meet these conditions it was decided to shape the bottom with a relatively narrow dry-weather channel, 150 ft. wide, 8 ft. deep below levee foot. For purposes of hydraulic computation the cross-section as a whole was considered to be trapezoidal, with flat bottom 3 ft. below the levee foot and 5 ft. about the floor of the low-water channel. This channel was located so far as practicable along the existing thread of the stream, that is, it was placed along the outside of curves. In general its near side was kept at least 75 ft. away from the levee foot. Partial plans of the Dayton and Hamilton protection and some typical channel sections given herewith show the characteristics of the adopted design.

Uniformity of Channel—Uniformity of channel cross-section had received little or no attention prior to the Conservancy District's work, but in planning for the improvement it was regarded as an important feature. There were considerable irregularities of width, due in part to encroachment on the natural channel and in part to widening of the channel by excavations and the like. The new improvement was so planned as to take up these irregularities and make the channel approximately uniform along its length.

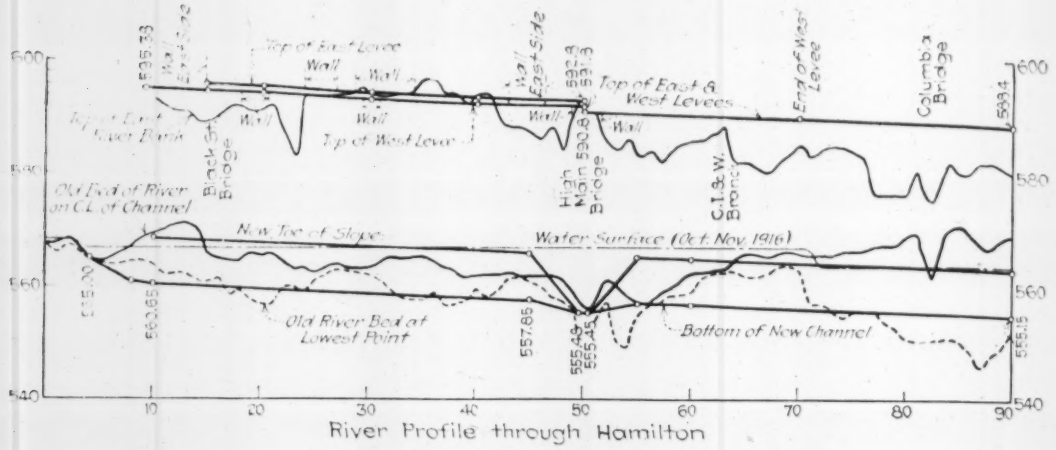
Just above the junction of the Mad River with the Miami in the upper part of Dayton there was a large basin, and the Herman Ave. bridge, which crosses just above this basin, is in fact the longest in the city. This basin is being filled, behind levees so laid out as to maintain the widths of both main and tributary streams and form a junction of good hydraulic character (see airplane view, Fig. 4). It is believed that this change avoids the formation of a break in the profile of the river, and prevents periodic deposition and cutting of the stream. The basin was of such shape and size as to favor the deposit of material and the growth of brush and trees (see view Fig. 1). While the improvement of the channel alignment has not been fully completed, and no test of the benefit that will be derived from the change has yet been obtained, it is worth note that a freshet during the last of April, 1920, which gave the highest stage at Dayton since 1913, reached a depth above the improvement very appreciably less than previous determinations of flow had indicated for the unimproved channel. Some distance downstream a wide bay-like expansion of the river above the mouth of Wolf Creek, which tended to form a bank in the river opposite the mouth of the creek, is being eliminated by narrowing, while a little farther down, toward the center of Dayton, some fills made many years ago by material excavated from the river bottom contracted the width, and these are to be cut away.

With the same general object of uniformity in mind, care was taken in laying down the alignment of the channel to obtain gradual transition from curve to curve, by interposing sections of tangent. The channel was also slightly widened at the curves.

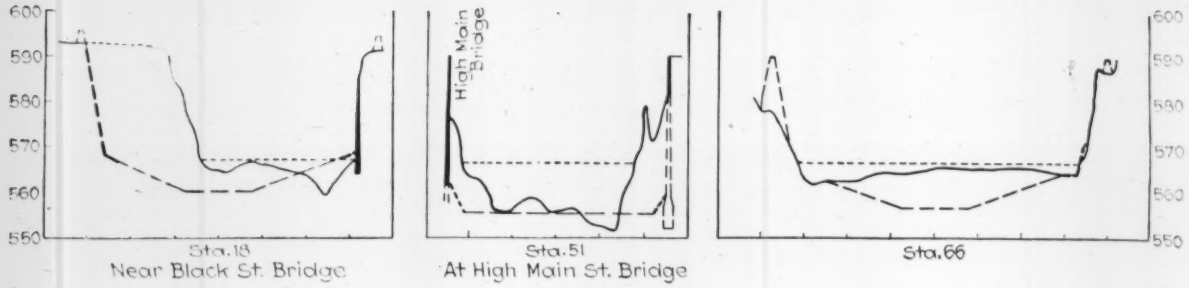
To allow for the influence of curvature of channel on the transverse water profile, the levees are in some instance being built 6 in. higher on the outside of curves. However, the greatest observed cross slope (as computed from flood levels) is not over 0.3 ft.

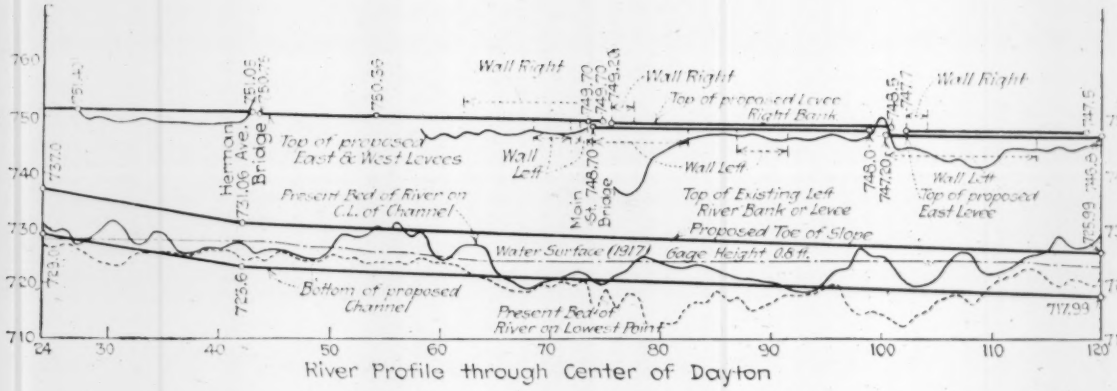
Modification at Bridges—To allow for the contraction of waterway at bridges the channel was modified here by slight deepening. Instances of this may be seen in the plan Fig. 5. The flat bottom of the low-water channel is widened out from the normal 150-ft. width, in some cases to practically the full width between levees, and the slopes from channel bottom to levee foot are correspondingly adjusted. In one or two cases, particularly at Main St. Bridge, Hamilton, the channel is also deepened several feet under the bridge.

Scour and Scour Protection—From observations of the effects of the 1913 flood it was concluded that a maximum flood-flow velocity of 8 ft. per sec. might be counted on without introducing serious difficulties in maintaining channel works. This is slightly higher than the flood velocities under the old channel conditions. While the increase would mean scour, scour is not necessarily destructive, it was considered. The action of the river upon its bottom is essentially a replacement of material, the erosion and deposition largely balancing; and the result of this balance is the present stable bed. The same stability, it was held, could be secured still more dependably in the new channel, provided scour at the weakest points of the cross-section were prevented.

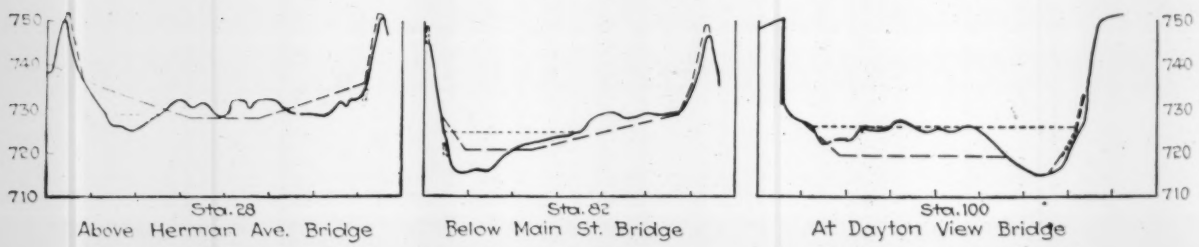

Top of East Levee
Wall
Top of East & West Levees
End of West Levee
Columbia Bridge
Black St. Bridge
High Main Bridge
C.I.&W. Bridge
Old Bed of River on C.L. of Channel
New Toe of Slope
Water Surface (Oct. Nov. 1916)
Old River Bed at Lowest Point
Bottom of New Channel

River Profile through Hamilton




Wall Right
Top of proposed Levee Right Bank
Herman Ave. Bridge
Top of proposed East & West Levees
Wall Left
Main St. Bridge
Present Bed of River on C.L. of Channel
Top of Existing Left River Bank or Levee
Top of proposed East Levee
Proposed Toe of Slope
Water Surface (1917) Gage Height 0.8 ft.
Bottom of proposed Channel
Present Bed of River on Lowest Point

River Profile through Center of Dayton



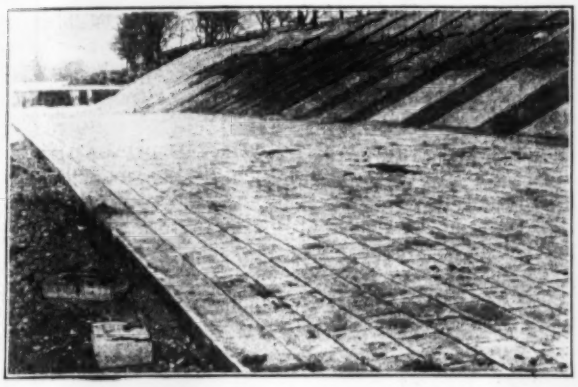
FIGS. 6 AND 7. PROFILES AND CROSS-SECTION OF MIAMI RIVER CHANNEL, AS FOUND AND AS IMPROVED

Those weak points were the angle at the levee foot, and the piers of bridges.

Two radically different means were adopted for the protection of these points. Along the outside of curves in the channel, and on sections of straight channel where the velocity is extreme, the toe of the levee has concrete scour protection. This consists of two portions: On the levee slope itself, from the foot up to the level where a turf can be maintained, the slope is paved with a solid concrete slab; its average height is 6 ft. (vertical) above the toe of the slope, or 14 ft. above the channel bottom. Stages higher than 5 or 6 ft. seldom last more than a day or two and are not expected to drown the grass. From the toe outward, a flexible mat of concrete is provided. Its intended service is to provide protection against a possible 15-ft. depth of scour near the center of the channel; accordingly the mat is being built from 10 to 30 ft. wide, depending on the location of the low-water channel.

Where property damages make sloping bank and levee construction too costly because of space required, retaining walls are built. The foundation soil is in all cases excellent, being a firm gravel; nevertheless piles are driven for the wall foundation support in many cases, as extra protection against a rather remote chance of local undermining by flood currents.

Types of Channel Improvement—Much if not all of the preceding description relates to the work at Dayton and Hamilton, which is essentially a matter of channel enlargement. On the other hand, the local protection of a number of the small towns in the valley is pure levee protection (Miamisburg, Franklin, West Carrollton, Tippecanoe City). At Piqua, Troy, and Middletown, cities of intermediate size, the local protection is a combination of channel widening and levee construction.



FIGS. 8 AND 9. CONCRETE PROTECTION BELOW ISLAND PARK DAM, AND EFFECT OF APRIL FRESHET ON FLEXIBLE-SLAB MAT

At bridges with shallow pier foundations, protective sheeting around the piers and various methods of underpinning were considered. Finally both these means of protection were rejected, however, and a sill of steel sheeting along the downstream side of the row of piers was adopted, as being both cheaper and safer. It is believed to be safer because longer piles can be driven in the sill than in an inclosure of sheeting around each pier and because the sill retains material between piers and so maintains the support of the pier foundation.

Levees—On account of the short time of exposure of levees to flood stages, along the Miami, the service required of them is not severe. With a few exceptions of damage by local scour, no difficulties had developed in connection with levees in prior floods, so long as they were not overtopped. Nevertheless, for the new levee construction and the levee raising required in the channel improvement, proportions somewhat more ample than those previously customary were adopted.

In the new design the top width is 8 ft. and the side slopes (both water and land sides) are 2:1 for the first 10 ft. from the top, 2½:1 for the next 10 ft. and 3:1 for additional height of slope. No core wall is used, and any of the usual methods of filling are considered acceptable in construction. Where necessary for permanence the soil of the natural ground surface is stripped of organic matter before building the embankment, and the natural surface is always roughened to bond the new embankment. Both slopes are sodded.

In the planning of the local protection work, property conditions and the like played a controlling part at many points. For this reason the broader engineering deductions that guided the work at Dayton and Hamilton were of little influence on the work at the smaller cities.

Hydraulic Calculations—Following the 1913 flood, when the Miami Conservancy District was formed, the engineers of the District made detail observations of every flood, determined the slopes, measured cross-sections, and calculated values of the roughness factor n of the Kutter formula. From these studies it was concluded that for the old channel the value of n is close to 0.025. The new channel, being smoother and more regular, is likely to have a lower roughness factor, but the same value 0.025 was used in calculations for flow in the improved channel. The effect is that all calculations for future floods indicate higher stages than are likely to be reached, so that the design includes a small extra margin of safety. On the other hand, no allowance has been made in the calculations for extra resistance in the curves of the alignment.

In determining flood profiles for the improved channel, the datum point was usually taken at the downstream end of a section, where the stage for a flood of volume equal to the "controlled maximum" could be approximated by interpolating between the 1898 and 1913 flood-stage marks. Thus, at the lower end of Dayton the elevations of the 1898 flood (90,000 cu.ft. per sec.), and of the 1913 flood (250,000 sec.-ft.) being known, the stage for the future "controlled maximum" with a flow of 125,000 sec.-ft. was interpolated by reference to an

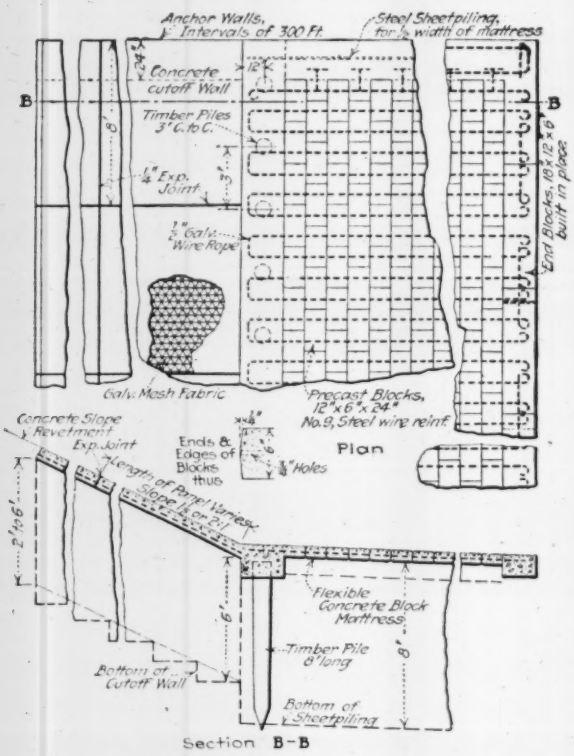

Anchor Walls, Intervals of 300 Ft.
Steel Sheetpiling, for ½ width of Mattress
Concrete cutoff Wall
Timber Piles 3' C. to C.
1" Exp. Joint
½" Galv. Wire Rope
End Blocks, 18" x 12" x 6" built in place
B
B
Galv. Mesh Fabric
Precast Blocks, 12" x 6" x 24" No. 8, Steel wire reinf.
Concrete Slope Revetment
Exp. Joint
Ends & Edges of Blocks thus
¾" Holes
Plan
Flexible Concrete Block Mattress
Timber Pile 8' long
Bottom of Cutoff Wall
Bottom of Sheetpiling
Section B-B

FIG. 10. DETAILS OF LEVEE REVETMENT AND FLEXIBLE CONCRETE MAT

assumed curve of relation between stage and discharge. Then, applying the Kutter formula with the roughness factor of 0.025 already mentioned, the backwater curve was constructed upstream from this point. Any error in the flood stage initially assumed tended to correct itself in a relatively short distance by the resulting adjustment of the rate at which the computed surface slope approached the channel bottom slope.

Under the uniform channel conditions which the construction through Hamilton and Dayton aims to secure, the hydraulic calculations involved no important elements beyond those mentioned. At some other points, however, special devices had to be used for meeting abnormal conditions. For example, in one of the smaller cities the Miami River, which here flows eastward, is crossed by an old highway bridge of inadequate size of waterway. On the north bank, opposite the city, lies a wide strip of land of relatively low elevation which under present conditions is overflowed every few years. In order to protect this land from overflow a levee and a bridge of ample waterway would have been required. The expense did not seem warranted, however, and it was decided to continue the plain north of the river in use as overflow channel. The land was therefore bought and is now being rented for farming purposes.

In making flow calculations for this part of the river, the flood-stage cross-section, consisting of a narrow, deep channel and a wide, shallow extension on one side, was divided into two parts for the computation, as the flow velocity in such a basin is by no means uniform. The main channel was taken as a section with full wetted perimeter, because of the retarding influence of the water in the shallow portion. For the shallow part, however, the hydraulic radius was computed from bottom and landward side only. The separate disch calculations for the two parts were added to give total flow in the cross-section.

The flood project of the Miami Conservancy Dist is being worked out under the general direction Arthur E. Morgan, Chief Engineer, and Chas. H. P Assistant Chief Engineer. The details of the chan enlargement plans were worked out largely by J. Kimball, Construction Engineer, who has direct supe vision over that section of the work.

Points in Elevated Railway Design From Philadelphia Experience

IN designing the new Woodland Ave. elevated stru ture of the Darby line which is to be built as a extension of Philadelphia's rapid-transit system, th engineers of the city's Department of Transit are mak ing specific application of certain experiences resultin from the construction of the Frankford elevated lin and the earlier Market St. line. The principal point in question are those relating to station-entrance loca tion, cross-bent construction, and floor construction.

All station entrances of the Frankford elevated lin were placed off the street area, to avoid obstructing the sidewalk with stairs, as the sidewalks are generally not over 12 ft. wide. But placing the entrances within the block area proved very costly. Land damages (fixed by condemnation proceedings) were in some cases as high as three times the assessed valuation of the properties taken; and, further, the buildings housing the entrances turned out to be rather expensive as mere stair enclosures and waiting rooms. For these reasons it has been decided to place the station entrances of the Woodland Ave. line on the sidewalks, which on that street are 18 ft. wide, says H. H. Quimby, chief engineer of the Department of City Transit, in the annual report of the department just issued. Mezzanine floor stations will probably be adopted, having fare-collector booths and other public facilities on a floor intermediate between the street and the track floor. This type, which is low in first cost and economical in operation, since one fare collector will serve traffic in both directions during slack hours, is considered to have proved satisfactory in its use on the more recent elevated lines in New York and Brooklyn.

Single-column bents were used on a part of the Frankford line to avoid obstructing the sidewalks by having columns near the curbs. This type was adopted there because of the urgent demand of local business men's associations and because of the exceptional narrowness of the sidewalks. However, it is not regarded as a desirable type, states Mr. Quimby, because of the impracticability of making it satisfactorily rigid and because of its obstruction to vehicular traffic. The bent consists of a wide base section or shoe, a column 5 ft. wide, and a cap bracketed out to carry the longitudinal track girders. The deflection of such a bent when carrying a train on only one track, which amounts to about ¼ to ⅜ in., is distinctly perceptible and is considered undesirably large. Further, the 5-ft. width of column in the middle of the street reduces the effective width of the roadway excessively and tends to prevent fast-moving vehicles from passing others. Since the wider sidewalks of Woodland Ave. make side columns unobjectionable, the ordinary bent construction with trans-

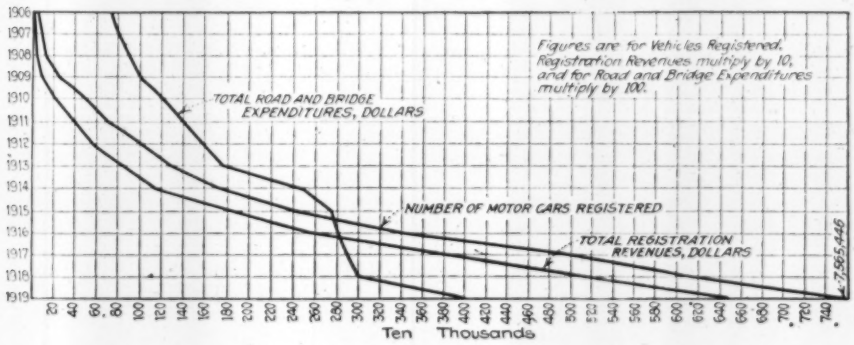
verse main girders carried by columns at the curb line is being adopted.

Ballasted solid-slab deck construction is to be used in general on the Woodland Ave. line "to give a high grade of street protection against dirt and noise, with economy of expenditure." The ballasted solid floor has proved very successful on the Market St. elevated line between the Schuylkill River and 63rd St. and is regarded as being the least noisy type. However, in front of station platforms, where trains are expected to be less noisy because they slacken speed and where litter is apt to accumulate and the track must be cleaned frequently, and at one or two other points, the track will be of subway type, with rails carried on short wood blocks embedded in concrete; this type, though costing a little more than the ballasted floor construction, is expected to be cheaper in maintenance and "may prove to be equally as quiet as the ballasted track." The concrete deck in either case consists of small arches carried on transverse steel beams, with concrete curb along either edge to retain the ballast. Mr. Quimby describes this construction as economical and substantial, having been found so not only on the elevated lines but also on many of the Philadelphia bridges.

States Register 7,565,446 Motor Vehicles During 1919

A TOTAL of 7,565,446 motor cars, including commercial vehicles, and 241,038 motorcycles were registered in 1919 in the forty-eight states and the District of Columbia. The registration and license fees, including those for chauffeurs, operators, and dealers, amounted to a total of $64,697,255.58. There are about 2,475,000 mi. of roads in the United States outside towns and cities, or an average of 3 cars per mile.

Compared with 1918 the data for 1919 represents an increase of 23 per cent, or 1,418,829 motor vehicles. This increase alone represents about 10 per cent more cars than the total number registered in the United States during the calendar year 1913. In this connection it is interesting to note that the number of cars registered during 1919 in the two states of New York and Pennsylvania exceeded the total number of cars registered in the entire United States in 1912, while the revenues derived from the New York and Pennsylvania registrations during 1919 were about double those derived from all motor vehicle registration and licenses in the entire United States in 1912. The revenues derived from all registration and licenses during the year 1919 exceed those of 1918 by 20 per cent, or a total of $13,219,838.97. In 1914 the total gross revenues collected amounted to only $12,381,951.


1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
Figures are for Vehicles Registered. Registration Revenues multiply by 10, and for Road and Bridge Expenditures multiply by 100.
TOTAL ROAD AND BRIDGE EXPENDITURES, DOLLARS
NUMBER OF MOTOR CARS REGISTERED
TOTAL REGISTRATION REVENUES, DOLLARS
7,565,446
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720 740
Ten Thousands

MOTOR VEHICLE INCREASE 1906-1919

The increase in motor car registration and revenues in the United States during the past dozen years presents many intersting comparisons. This is especially true in respect to the use made of the revenues. In 1906 the total registrations were approximately 48,000 cars, paying a gross revenue of about $193,000, or slighily more than that collected during 1919 by the state of Arizona. Furthermore, in 1906 the gross registration revenues were equivalent to less than three-tenths of 1 per cent of the total road and bridge expenditures for that year. In 1919 the motor vehicle revenues represented approximately 16 per cent of the total road and bridge expenditures for the year. Furthermore, while in 1906 practically none of the motor vehicle revenues were applied to road maintenance and construction, in 1919 more than 92 per cent of the gross returns, or $59,907,136.18 was devoted to this purpose, and of the total amount applied to road work, 70 per cent was expended more or less directly or under the control or supervision of the state highway departments. The remaining 8 per cent not applied to road work was expended very largely for number plates and carrying out the provisions of the motor vehicle registration laws of the state.

The approximate relations and rates of variation of the three factors—total rural road and bridge expenditure, motor vehicle registration and license revenues, and number of motor car registrations from 1903 to 1919, inclusive—are shown graphically on the accompanying chart.—*Public Roads.*

Lumbermen for American Forest Policy

A declaration for "an American forest policy which shall substitute for indifference and accident an intelligent, practical, equitable, and concerted program for the perpetuation of the forests" was made at the recent convention of the National Lumber Manufacturers' Association (Chicago) which represents about 75 per cent of the privately owned timberlands of the United States. Their platform contained this declaration.

The lumbermen believe:

That growing future timber crops must be largely, though by no means wholly, a Government [Federal] and state function;

That Government and states should be permitted to condemn any deforested land classified as suitable chiefly for forest growing and pay for it at prices comparable to those paid in voluntary transactions;

That land classification and studies should be undertaken jointly by industry, states and by the Government.

That the Forest Service should be the recognized leader of public forestry thought and effort along general lines;

That wise conservation requires the determination of better methods of waste prevention and of utilization of the forests we already have;

That a successful forest policy means much more than tree-growing. It means confidence and security in every legal and commercial phase, to industry and public alike.

New York City Concrete Flat-Slab Regulations

New Standards Adopted for All Boroughs of City After Conference with Engineers and Architects

REGULATIONS for the design of reinforced-concrete girderless or flat-slab floors have been adopted by the Board of Standards and Appeals of New York City for the uniform use of all the boroughs of the city. They went into effect Aug. 2, 1920, and superseded all previous regulations in force in the various boroughs. The new regulations were the result of a number of conferences between the city board and a committee of architects and engineers.

VARIOUS MOMENT FACTORS FOR CONCRETE FLAT SLABS

Capital = 0.225 L
Drop = 0.33 L

Authority	Moment Sections — 2-Col Head	Midspan	Inner	2 Outer	Total Moment	Remarks
New York City 1920 Rules	1/32	−1/133	+1/133	+1/80	1/17	
Bor. of Manhattan, Old Rules	1/24	−1/140	+1/140	+1/48	1/13	
Chicago	1/30	−1/120	+1/120	+1/60	1/15	On basis of f_s = 18,000
Philadelphia	1/32	−1/128	+1/128	+1/80	1/16.9	
Pittsburgh	1/29.6		+1/128	+1/64	1/15.4	
Detroit	1/31	−1/116	+1/116	+1/62	1/15.3	
St. Louis	1/33	−1/133	+1/133	+1/67	1/16.6	
Joint Committee	1/26*	−1/104	+1/138	+1/58	1/13	{ Pos. Mom. = 37½% total { Neg. Mom. = 62½% total
Joint Committee	−1/42†	.....	.....	.....	.....	
Am. Conc. Inst.	−1/30.8*	−1/154	+1/128	+1/85.5	1/15.4	{ Pos. Mom. = 33⅓% total { Neg. Mom. = 66⅔% total
Am. Conc. Inst.	−1/38.5†	.....	.....	.....	.....	

* With drop panel. † Without drop panel. ‡ Minimum specified values for each section.

In connection with the new regulations there is also shown a table giving the moment coefficients in a number of the regulations standard in different sections of the country.

Rule 1. Application. The rules governing the design of reinforced-concrete flat slabs shall apply to such floors and roofs, consisting of three or more rows of slabs, without beams or girders, supported on columns, the construction being continuous over the columns and forming with them a monolithic structure.

Rule 2. Compliance with Building Code. In the design of reinforced-concrete flat slabs, the provisions of article 16 of the building code shall govern with respect to such matters as are specified therein.

Rule 3. Assumptions. In calculations for the strength of reinforced-concrete flat slabs, the following assumptions shall be made:

(a) A plane section before bending remains plane after bending;

(b) The modulus of elasticity of concrete in compression within the allowable working stresses is constant;

(c) The adhesion between concrete and reinforcement is perfect;

(d) The tensile strength of concrete is nil;

(e) Initial stress in the reinforcement due to contraction or expansion in the concrete is negligible.

Rule 4. Stresses. (a) The allowable unit shear in reinforced concrete flat slabs on *bd* section around the perimeter of the column capital shall not exceed 120 lb. per square inch; and the allowable unit shearing stress on the *bjd* section around the perimeter of the drop shall not exceed 60 lb. per square inch, provided that the reinforcement is so arranged or anchored that the stress may be fully developed for both positive and negative moments.

(b) The extreme fiber stress to be used in concrete in compression at the column head section shall not exceed 750 lb. per square inch.

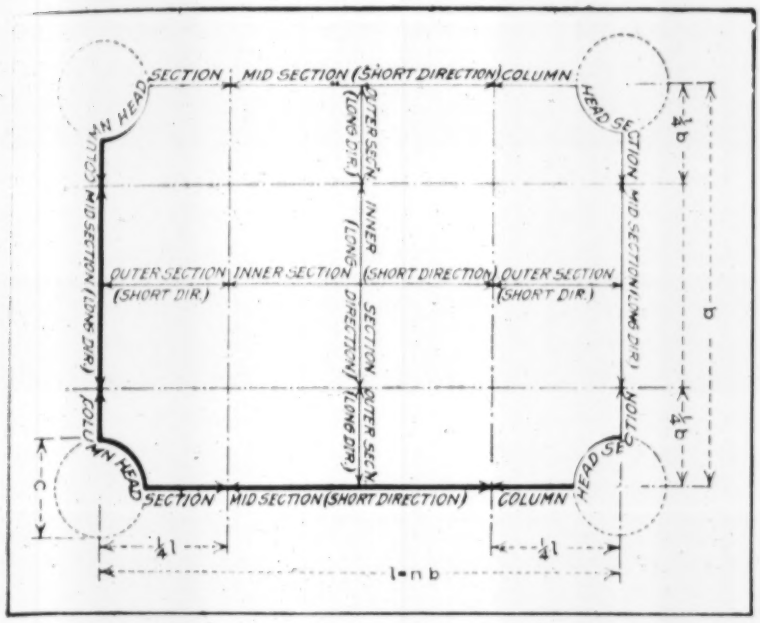
Rule 5. Columns. For columns supporting reinforced-concrete flat slabs, the least dimension of any column shall be not less than one-fifteenth of the average span of any slab supported by the columns; but in no case shall such dimension of any interior column supporting a floor or be less than 16 in. when round nor 14 in. when square; shall the least dimension of any exterior column be than 14 in.

Rule 6. Column Capital. Every reinforced-con column supporting a flat slab shall be provided wi capital whose diameter is not less than 0.225 of the ave span of any slabs supported by it. Such diameter shall measured where the vertical thickness of the capital least 1½ in., and shall be the diameter of the inscribed ci in that horizontal plane. The slope of the capital con ered effective below the point where its diameter is m ured shall nowhere make an angle with the vertical of m than 45 deg. In case a cap of less dimensions than here after described as a drop, is placed above the column ca ital, the part of this cap enclosed within the lines of th column capital extended upward to the bottom of the sla or drop at the slope of 45 deg. may be considered as part of the column capital in determining the diameter for design purposes.

Rule 7. Drop. When a reinforced-concrete flat slab is thicker in that portion adjacent to or surrounding the column, the thickened portion shall be known as a drop. The width of such drop when used, shall be determined by the shearing stress in the slab around the perimeter of the drop, but in no case shall the width be less than 0.33 of the average span of any slabs of which it forms a part. In computing the thickness of drop required by the negative moment on the column head section, the width of the drop only shall be considered as effective in resisting the compressive stress, but in no case shall the thickness of such drops be less than 0.33 of the thickness of the slab. Where drops are used over interior columns, corresponding drops shall be employed over exterior columns and shall extend to the one-sixth point of the panel from the center of the column.

Rule 8. Slab Thickness. The thickness of a reinforced-concrete flat slab shall be not less than that derived by the formula $t = 0.024\ L\ \sqrt{w} + 1\frac{1}{2}$ for slabs without drops, and $t = 0.02\ L\ \sqrt{w} + 1$ for slabs with drops, in which t is the thickness of the slab in inches, L is the average span of the slab in feet, and w is the total live and dead load in pounds per square foot; but in no case shall this thickness be less than one-thirty-second of the average span of the slab for floors, nor less than one-fortieth of the average span of the slab for roofs, nor less than 6 in. for floors nor less than 5 in. for roofs.

Rule 9. Reinforcement. (a) In the calculation of moments at any section, all the reinforcing bars which cross that section may be used, provided that such bars extend far enough on each side of such section to develop the full amount of the stress at that section. The effective area of the reinforcement at any moment section shall be the sectional area of the bars crossing such section multiplied by the sine of the angle of such bars with the plane of the section. The distribution of the reinforcement of the several bands shall be arranged to fully provide for the intermediate moments at any section.



PLAN OF FLAT SLAB SHOWING NOTATION

(b) Splices in bars may be made wherever convenient but preferably at points of minimum stress. The length of any splice shall be not less than 80 bar diameters and in no case less than 2 ft. The splicing of adjacent bars shall be avoided as far as possible. Slab bars which are lapped over the column, the sectional area of both being included in the calculation for negative moment, shall extend to the lines of inflection beyond the column center.

(c) When the reinforcement is arranged in bands, at least 50 per cent of the bars in any band shall be of a length not less than the distance center to center of columns measured rectangularly and diagonally; no bars used as positive reinforcement shall be of a length less than one-half the panel length plus 40 bar diameters for cross bands, or less than seven-tenths of the panel length plus 40 bar diameters for diagonal bands and no bars used as negative reinforcement shall be of a length less than one-half the panel length. All reinforcement framing perpendicular to the wall in exterior panels shall extend to the outer edge of the panel and shall be hooked or otherwise anchored.

(d) Adequate means shall be provided for properly maintaining all slab reinforcement in the position as assumed by the computations.

Rule 10. Line of Inflection. In the design of reinforced-concrete flat-slab construction, for the purpose of making calculations of the bending moments at sections other than defined in these rules, the line of inflection shall be considered as being located one-quarter the distance, center to center, of columns, rectangularly and diagonally, from center of columns for panels without drops, and three-tenths of such distance for panels with drops.

Rule 11. Moment Sections. For the purpose of design of reinforced-concrete flat slabs, that portion of the section across panel, along a line midway between columns, which lies within the middle two quarters of the width of the panel shall be known as the inner section, and those portions of the section in the two outer quarters of the width of the panel shall be known as the outer sections. Of the section which follows a panel edge from column to column and which includes the quarter perimeters of the edges of the column capitals, that portion within the middle two quarters of the panel width shall be known as the mid section and the two remaining portions, each having a projected width equal to one-quarter of the panel width, shall be known as the column head sections.

Rule 12. Bending Moments. In the design the following provisions with respect to bending moments shall be observed. In the moment expressions used:

W is the total dead and live load on the panel under consideration, including the weight of drop whether a square, rectangle or parallelogram;

W_1 is the total live load on the panel under consideration;

L is the length of side of a square panel center to center of columns; or the average span of a rectangular panel which is the mean length of the two sides;

n is the ratio of the greater to the less dimension of the panel;

h is the unsupported length of a column in inches, measured from top of slab to base of capital;

I is the moment of inertia of the reinforced-concrete column section.

A. Interior Square Panels. The numerical sum of the positive and negative moments shall be not less than 1/17 $W L$. A variation of plus or minus 5 per cent shall be permitted in the expression for the moment on any section, but in no case shall the sum of the negative moment be less than 66 per cent of the total moment, nor the sum of the positive moments be less than 34 per cent of the total moments for slabs with drops; nor shall the sum of the negative moments be less than 60 per cent of the total moment, nor the sum of the positive moments be less than 40 per cent of the total moment for slabs without drops.

1. In *two-way systems*, for slabs with drops, the negative moment resisted on two column head sections shall be $-$ 1/32 $W L$; the negative moment on the mid section shall be $-$1/133 $W L$; the positive moment on the two outer sections shall be + 1/80 $W L$ and the positive moment on the inner section shall be + 1/133 $W L$ and for slabs without drops, the negative moment resisted on two column head sections shall be $-$ 1/36 $W L$, the negative moment on the mid section shall be $-$ 1/133 $W L$, the positive moment on the two outer sections shall be + 1/63 $W L$ and the positive moment on the inner sections shall be + 1/133 $W L$.

2. In *four-way systems*, the negative moments shall be as specified for two-way systems; the positive moment on the two outer sections shall be + 1/100 $W L$, and the positive moment on the inner section shall be + 1/100 $W L$ for slabs with drops; and the positive moment on the two outer sections shall be + 1/74 $W L$, and the positive moment on the inner section shall be + 1/100 $W L$, for slabs without drops.

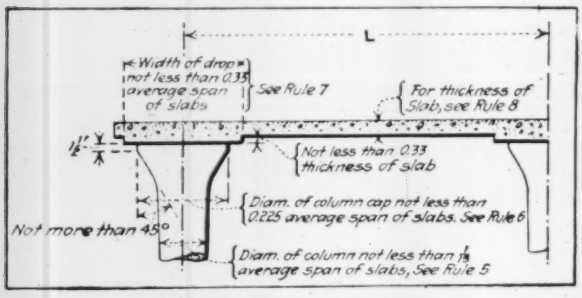
3. In *three-way systems*, the negative moment on the column head and mid sections and the positive moment on the two outer sections, shall be as specified for four-way systems. In the expression for the bending moments on the various sections, the length L shall be assumed as the distance center to center of columns, and the load W as the load on the parallelogram panel.

B. Interior Rectangular Panels.

1. When the ratio n does not exceed 1.1, all computations shall be based on a square panel of a length equal to the average span, and the reinforcement shall be equally distributed in the short and long directions according to the bending moment coefficients specified for interior square panels.

2. When the ratio n lies between 1.1 and 1.33, the bending moment coefficients specified for interior square panels shall be applied in the following manner:

(a) In *two-way systems*, the negative moments on the two column head sections and the mid section and the positive moment on the two outer sections and the inner section at right angles to the long direction shall be determined as for a square panel of a length equal to the greater dimension of the rectangular panel; and


L
Width of drop not less than 0.35 average span of slabs
See Rule 7
For thickness of Slab, see Rule 8
Not less than 0.33 thickness of slab
Diam. of column cap not less than 0.225 average span of slabs. See Rule 6
Not more than 45°
Diam. of column not less than 1/5 average span of slabs, See Rule 5

SECTION THROUGH SLAB

the corresponding moments on the sections at right angles to the short direction shall be determined as for a square panel of a length equal to the lesser dimension of the rectangular panel. In no case shall the amount of reinforcement in the short direction be less than two-thirds of that in the long direction. The load *W* shall be taken as the load on the rectangular panel under consideration.

(b) In *four-way systems*, for the rectangular bands, the negative moment on the column head sections and the positive moment on the outer sections shall be determined in the same manner as indicated for *two-way systems*.

For the diagonal bands, the negative moments on the column head and the mid sections and the positive moment on the inner section shall be determined as for a square panel of a length equal to the average span of the rectangle. The load *W* shall be taken as the load on the rectangular panel under consideration.

(c) In *three-way systems*, the negative and positive moments on the bands running parallel to the long direction shall be determined as for a square whose side is equal to the greater dimension; and the moments on the bands running parallel to the short direction shall be determined as for a square whose side is equal to the lesser dimension. The load *W* shall be taken as the load on the parallelogram panel under consideration.

C. Exterior Panels. The negative moments at the first interior row of columns and the positive moments at the center of the exterior panels on moment sections parallel to the wall, shall be increased 20 per cent over those specified above for interior panels. The negative moment on moment sections at the wall and parallel thereto shall be determined by the conditions of restraint, but the negative moment on the mid section shall never be considered less than 50 per cent and the negative moment on the column head section never less than 80 per cent of the corresponding moments at the first interior row of columns.

D. Interior Columns shall be designed for the bending moment developed by unequally loaded panels, eccentric loading or uneven spacing of columns. The bending moment resulting from unequally loaded panels shall be considered as 1/40 *W*, *L*, and shall be resisted by the columns immediately above and below the floor line under consideration in direct proportion to the values of their ratios of *I*/*h*.

E. Wall Columns shall be designed to resist bending in the same manner as interior columns, except that *W* shall be substituted for W_1 in the formula for the moment. The moment so computed may be reduced by the counter moment of the weight of the structure which projects beyond the center line of the wall columns.

F. Roofing Columns shall be designed to resist the total moment resulting from unequally loaded panels, as expressed by the formula in paragraphs *D* and *E* of this rule.

Rule 13. Walls and Openings. In the design and construction of reinforced-concrete flat slabs, additional slab thickness, girders or beams shall be provided to carry any walls or concentrated loads in addition to the specified uniform live and dead loads. Such girders or beams shall be assumed to carry 20 per cent of the total live and dead panel load in addition to the wall load. Beams shall also be provided in case openings in the floor reduce the resisting strength of the slab below the prescribed carrying capacity.

Rule 14. Special Panels. For structures having a width of less than three rows of slabs, or in which extended drops, capitals or columns are omitted, or in which irregular or special panels are used, and for which the rules relating to the design of reinforced flat slabs do not directly apply, the computations in the analysis of the design of such panels shall, when so required, be filed with the superintendent of buildings.

Wire Mesh Army Roads in Egypt

By T. McLean Jasper
Assistant Professor of Mechanics, University of Wisconsin

Loose sand, smoothed and leveled and then covered with chicken netting, firmly pegged down, made roads which gave such good service during the British Army operations in Egypt and Palestine that this method of construction appears to offer possibilities for temporary roads for construction and engineering operations where travel over sand is necessary. Brief descriptions of the military roads received in letters from Brig. Gen. P. Link, of the Britsh Army, and Capt. Arthur Roberts, of Mather & Platt, Ltd., engineers, Manchester, England, furnish the following information:

As laid down by the army troops, states Capt. Roberts, the best results were obtained with chicken netting of about ¾-in. mesh. This netting, 2½ or 3 ft. wide, came in rolls and four or five rolls placed end to end were unrolled along the route so as to cover a strip about 12 or 15 ft. wide. The joining edges of the netting were fastened together either by clipping on loops of wire at about 3-ft. intervals or by a continuous wire woven in and out of the two edges. At intervals of about 5 ft. the outside edges were pegged down with 1½-in. stakes from 12 to 18 in. long. Roads so constructed were perfectly satisfactory for infantry but were badly damaged if horses or cars were driven over them. The life of these roads is difficult to state. Captain Roberts mentions one which had been marched over daily by 3,000 or 4,000 men and was in good condition after six months' use. Other roads, however, failed quite soon.

General Link mentions that the grade is leveled and smoothed before the netting is laid. No hollows should be left under the netting and the netting should be securely pegged down. As ruts form, the netting is lifted and the sand releveled. The netting lasts from three to six months, depending on the volume of traffic. Roads of this type, General Link points out, are of use only for mechanical transport with pneumatic tires; horse and wheel transport destroy them almost at once.

The World's Rainfall

The total annual rainfall upon all the land of the globe amounts to 29,347 cu.mi., according to a recent statement by the U. S. Geological Survey. Of this quantity, 6,524 cu.mi. drain off through rivers to the sea. A cubic mile of river water weighs about 4,205,650,000 tons and carries in solution an average of about 420,000 tons of foreign matter. In all, approximately 2,735,000,000 tons of solid matter are thus carried annually to the ocean.

Notes on the French Highway System

BY
E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

THE French road system was in bad condition after the war. In the war zone the highways were, necessarily, under continual maintenance, but elsewhere little or no attention could be given them. The restoration (bridges included) to pre-war condition will cost about 1,000,000,000 francs, assuming that the same type will be used as before the war—to waterbound macadam and stone-block. The work of restoration is now in hand, and good progress is being made. In the devastated regions there were new roads—stone-block chiefly—in such good condition that with a stiff-spring automobile —a *very* stiff-spring automobile—one could go along in comfort at 35 to 40 miles per hour.

As is well known, the French roads are paved chiefly with waterbound macadam. On the national highway system, the *routes nationales*, out of a total length of 38,000 km. the types comprised about 5,000 km. stone paved, 1,000 km. tar-sprayed waterbound macadam and the remainder, 32,000 km., waterbound macadam. The growing motor traffic, however, is forcing the preparation of plans for extensive strengthening of surfaces. Even now, though, the French traffic is very light compared with that of the United States or England. In the whole of France there are about 40,000 motor trucks and 100,000 passenger automobiles. Most of these operate only in the cities—the tremendous fleet of Paris taxis, for example, scarcely using the country roads at all

The French experience is, therefore, of relatively little value to us. On the other hand, we have much to learn from English experience, as has been pointed out in recent articles in the *Engineering News-Record.*

Strengthening of Surfaces

The plans being considered contemplate an extensive use of surface treatment, of asphalt macadam, of sheet asphalt and an extension of the mileage of stone-block pavement. The plans are not matured and, obviously, have not been put before the Parliament, but tentative estimates indicate that at present prices the strengthening of the more important routes will cost about 1,500,000,000 francs to be spent during six or seven years.

There is in France, because of our experience, considerable interest in concrete roads, but the attitude is a doubting one; in the surface-strengthening program concrete is not one of the types included. The general opinion is that it is unsuited to horse-drawn traffic, and the French engineers still remained incredulous after being told that in our farming districts objections from the farmers have totally disappeared.

However, they are giving concrete serious study and experimental sections will undoubtedly be laid. M. P. LeGavrian, *ingénieur en chef des Ponts et Chaussées,* has in fact just returned from a trip to northern Italy to study a patented type of concrete road being laid there.

In considerable favor is an asphaltic carpeting, 5 cm. (2-in.) thick, called "Mexphalt." It is virtually a sheet-asphalt wearing surface. Here, by the way, as in England, the new surfacing will be laid, not on concrete foundations, but on the old macadam, and for the same reason, that their well-matured roads make excellent foundations. By the end of this year there will be about 100 km. of Mexphalt surfacing, laid at a cost, including the reshaping of the old macadam, of 25 francs per square meter ($4.17 per square yard, normal exchange), as against 10 francs ($1.67) before the war.

The stone-block, so largely used in the north of France, consisting of porpyhry, granite and *grés* (the last being the same fine-grained sandstone used in Belgium), measure, generally, 14 x 20 cm., with depths varying from 11 to 16 cm. (5.5 x 7.9 in., by 4.3 to 6.3 in.) in depth. The cost is now 50 to 60 francs per square meter, against a pre-war figure of 18 to 19 francs. Stone-block pavements, under French traffic, have heretofore given from 20 to 24 years' service.

Cost of Macadam Roads

Naturally one is much intersted in the cost of the waterbound macadam roads—roads which have won such fame for France among highway engineers. Here are figures for stretches near Paris, where the passenger automobile traffic is considered very heavy, say a maximum of 1,000 cars a day, with probably 150 motor trucks. Under such conditions it is found necessary every three years to resurface the roads, while at all times a patrol system is maintained. The patrol work, if a patrolman has a 3-km. length (under the densest traffic this would be reduced to 2 km.), costs 400 francs per kilometer per year, or about $133 per mile per year. The resurfacing, 10 cm. (4-in.) thick, costs about 3 francs per square meter, and since it must be renewed every 3 years, the annual cost is 1 franc per square meter per year. This gives a resurfacing cost for an 18-ft. width of about $1,750 per mile per year. The cost of the maintenance stone used by the patrolman may be considered negligible. The total cost per mile per year, then, is $1,750 + $133 or $1,883. It must be remembered that this is not the average cost for French roads, but for roads under what they consider heavy traffic. Such a section has been purposely selected in order to afford some comparison without traffic conditions. *The figures are pre-war costs.*

French macadam roads, therefore, under traffic conditions similar to ours show an equally high maintenance cost, which, of course, one would have been justified in predicting.

Regarding the national road system generally, I was interested in learning why our engineers who had been in France during the war were very reticent about the roads. We had, in the past, heard so much about the *routes nationales* that one expected extended commentaries from the returned engineer officers. But the comments were not forthcoming. Particularly did one expect comment on the matter of drainage, for which France has a high reputation. The reason for the re-

licence is simply this: That there is little to say that we do not already know. The roads, long under careful maintenance, have in the course of years been well drained, but the methods are those standard with us—ditches, longitudinal tile and French drains, and herringbone drainage. The only point to be emphasized is that *they have actually applied these methods.* They have not merely considered them beautiful theories.

Again, with reference to their macadam construction, there is nothing mysterious. Under light traffic and good maintenance it gives good service at relatively low cost; under passenger automobile traffic the maintenance cost is high; under heavy motor-trucks in wet weather, as was proved during the war, the crusts break through and the road goes to pieces, just as with us.

There was disagreement among our engineers who had served in the A. E. F. as to the thickness of the stone crusts on French roads. Some said they were very thin; others had seen depths of 12 in. Very likely both claims were correct. There are thin crusts and thick crusts, but the engineers of the *Direction des Ponts et Chaussées* stated that as a rule the crusts are relatively thin, that resurfacing is done only when the crust has worn considerably. Probably these crusts will not average more than 7 in., for the depth of stone laid in resurfacing is only 10 cm. (4 in.).

Motor Vehicles

Naturally the regulation of motor vehicles is receiving serious consideration. At present there is a maximum speed limit of 18 miles per hour, but it is constantly violated. New regulations will shortly be promulgated and it is expected that different maximum speeds will be set for vehicles of different weights. Under these new regulations maximum loads per centimeter width of tire will be stipulated. The figure will probably be 150 kg. per centimeter width (825 lb. per inch width) whether the tire be of steel or rubber. It is probable that a maximum limiting gross weight will not be set.

In addition to the *routes nationales* built and maintained at the sole cost of the National Government (even, as in Belgium where they run through cities), there are two subsidiary highway systems: (1) the *chemins vicinaux*, built and maintained by the departments, and (2) the *chemins rurals*, maintained by the villages and local communities. Except in the north and in the mountain sections in the east and northeast, where stone-block is used, these subordinate systems use water-bound macadam exclusively.

In general, therefore, while the French highway system was a very excellent one for horse-drawn traffic, the surfaces must now be materially strengthened. In this respect the experience is the same as our own and that of England.

City Planning Progress at Indianapolis

The Board of Directors of the Indianapolis Chamber of Commerce has indorsed city planning recommendations submitted by a subcommittee of the Chamber's Municipal Research Committee. The directors have asked the subcommittee to work out a definite program for consideration by the board. Some of the subjects already taken up by the subcommittee are specially constructed streets for trucking, expansion of railroad terminals, industrial housing, zoning, the elimination of jogs in streets, and the grouping of civic centers. Frank Noll is chairman of the subcommittee.

Three State Courts Hold Cities May Regulate Garbage Disposal

THE State Supreme Courts of Missouri, Michigan and Utah have recently upheld contracts for garbage disposal that entitled the contractors to all garbage produced, notwithstanding the contention of some that the garbage was their own private property. These decisions were noted in *Public Health Reports* for May 28, June 4, and June 18, 1920.

The first case centered in an ordinance of the City of Joplin, Mo. (Valley Spring Hog Ranch Co. *v.* Plagmann et al., 220 S. W., 1), providing that the city may "contract with a suitable person, firm or corporation, for the exclusive right to dispose of the garbage of the city." The defendant in this case removed garbage in defiance of the ordinance, contending that the ordinance was void because it authorized the city to make an exclusive contract and because it was destructive of property rights. The State Supreme Court denied the injunction, holding that the city, in the language of *Public Health Reports*, "is exercising its police power in the interests of the public health and is not establishing a monopoly; and "that the value of the owner's rights in garbage [quoting now from the decision] 'is so inconsequential that they are absorbed and lost in the greater rights of the state to protect such owner and the public at large from the dire effects of improper methods in the handling and disposition of the same.'"

The Michigan Supreme Court decision (Pantlind, et al *v.* City of Grand Rapids, 177 M. W., 302) is thus summarized by *Public Health Reports*:

> The plaintiffs, proprietors of hotels and restaurants, conveyed to their farms outside the city and there fed to hogs and poultry the garbage from such hotels and restaurants. This was done in a cleanly manner, but was in violation of an ordinance of the city of Grand Rapids, and plaintiffs were notified by the city to discontinue such conveyance and disposal of their garbage.
>
> The plaintiffs thereupon sought an injunction to restrain the city from interfering. The lower court granted an injunction, but on appeal the supreme court reversed the decree and enjoined plaintiffs from conveying the garbage through the streets and from violating the garbage ordinance in any manner.
>
> In answer to the contention of plaintiffs that they had a right to dispose of garbage produced upon their own premises because it was property of value, and that as to them the ordinance was wanting in the due process of law required by the Constitution, the supreme court held that the city had the right to regulate the disposal of garbage and that the plaintiffs were compensated for any loss in the common benefit secured by the ordinance.

The Utah Supreme Court decision (Salt Lake City *v.* Bernhagen, 189 Pac., 583) is not summarized in detail in *Public Health Reports*, but the note on the subject indicates that this case is similar, at least in the general effect of the decision, to those already summarized.

Federal-Aid Road Work

According to information recently made public by the Bureau of Public Roads, up to May 1, 1920, various states had filed with the bureau 2,885 project statements, of which 2,790 had been approved, representing 27,796 mi. of highway. Practically two-thirds of that number of project statements have been submitted within the past year. Up to May 1 of this year progress agreements had been actually executed and construction started upon 1,569 projects aggregating 11,987 mi.

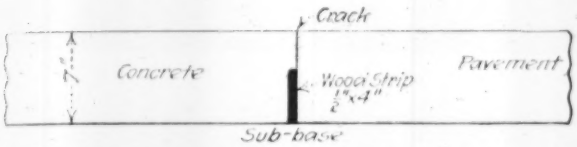
Concealed Joints in Road Slab Limit Surface Cracks

Extra Durable Road Procured by Wood Floating a Sifted Layer of Cement and Sand Into Green Concrete

By Samuel H. Lea
County Road Engineer, Keyser, W. Va.

CONCEALED weather-board joints and a float finish over dry sifted mortar produced a notably durable surface on the concrete road recently completed between Keyser and Piedmont, W. Va. Portions of the road which have carried heavy traffic for two years show no signs of wear. The surface is homogeneous and without breaks. These excellent results are attributed largely to the dry-mix float finish and to the unusual joint construction adopted.

The pavement is of one-course 1 : 2 : 4 concrete. It is 15 ft. wide, 5½ in. thick at the sides and 7 in. thick



WEATHERBOARD, SET BASE DOWN, FORMS CONCEALED JOINT

at the center. A hard, calcareous sandstone, occurring locally, was crushed on the job and used for coarse aggregate; the sand manufactured from sandstone at the quarries was purchased. Construction was carried on at two different periods from 1917 to 1919.

On the work done in 1917, transverse expansion joints were made at 50-ft. intervals except when there was a temporary stoppage or work was discontinued at night. In such cases the spacing between joints varied from 35 to 75 ft. Joints were filled with ¼ in., prepared joint filler cut to proper shape and projecting ½ in. above the pavement.

After resuming work in 1919, concealed joints were used. At the beginning of each day's work the stop board, which had been left in place, was removed and a strip of weatherboard ½ in. thick was placed, thick edge down, against the face of the old concrete, the top of the board being 3 in. below the surface of the pavement at the center of the road. The new concrete was placed directly against the face of the old work, covering the wooden strip and forming an unbroken surface with the old work. Two days after placing the joint a thin crack appeared on the surface of the pavement directly above each wooden strip. These cracks are like fine lines, and are straight across the pavement. During the ten months since the completion of work these joints have been closely observed. Last fall they were filled or covered over with melted tar but no appreciable widening was noticed.

Aside from the joints, the construction was the same during both working periods. The concrete was mixed quite stiff and after being shoveled into place, was struck off and tamped with a wooden templet weighing 250 lb. The strikeboard after advancing a few feet, while being alternately raised and lowered, was brought back and again moved forward, while being sawed across the roadway. A roller was used to remove excess water from the concrete. The first rolling was about 30 min. behind the templet and two subsequent rollings followed at intervals of about 20 min. After rolling, a dry mix composed of 1 part sand and 1 part cement was distributed evenly through a sieve over the concrete surface, which was then floated by the finisher from a bridge. Wooden floats were used and the dry mix was thoroughly rubbed into the concrete, absorbing any water remaining after the roller and forming a hard, durable surface.

That portion of the road built in 1917 shows no signs of wear although it has been subjected to a heavy traffic. This durability is largely attributed to the method of surface finish used. By using concealed joints, a homogeneous surface was obtained whose continuity is not marred by breaks or inequalities. The cracks form joints that are sufficiently narrow to prevent the passage of much water from the surface through them. The wooden strips prevent the penetration of water to the subgrade. They are sufficiently compressible to take care of ordinary expansion stresses. The joints have passed through one summer without injury, and it is hoped they will continue to function. In future work it is probable that a prepared joint filler will be used in place of wood for the concealed joints.

Water Supply and Disease in Rumania

AN INVESTIGATION of the sanitary conditions in Rumania, especially in regard to the menace of infectious diseases, has been made by Prof. George C. Whipple, as chief of the sanitation department of the League of Red Cross Societies. His report, as published in the League's bulletin for June, includes the following:

Prior to the war the country had a good history as to this disease [cholera]. The large cities were well supplied with water, many of these supplies being taken from safe subterranean sources, and the river water supplies being filtered. Since the war the water supply situation has been very bad. The supply at Bucharest is of safe quality but the population of the city has so increased that the supply is inadequate. At certain hours no water will run from the taps in many parts of the city. At Constantza the pumps are out of commission and the people are dependent upon the sale of bottled water from local wells, which are always likely to be contaminated, especially if drawn upon heavily. At Giurglu the filter is out of commission, and raw Danube water is being pumped. At Sulina, Galatz and Braila the water systems are also in bad condition, the purification plants being inoperative. All of the Rumanian water supplies are in charge of local municipal authorities.

If the water supplies are enlarged to provide for the increased populations in the cities there will have to be extensions which will require much engineering work, and this work is not likely to be undertaken until business conditions become more nearly normal. The Danube is used as a source of supply by several cities. Slow sand filters, in some cases accompanied by the use of ozone, provide the means of purification. The Danube water is very turbid and the means thus far adopted are not appropriate for this type of water. Mechanical filters using alum or some other substance as a coagulant would be far more efficient. Most of the local wells in the rural districts which we passed through seem to be fairly well constructed from the standpoint of protection against pollution through the soil or at the surface. There are said to be only six Roumanian cities which have sewer systems.

With the present military cordon maintained cholera is not likely to be a menace to Rumania, but the sanitary situation of the country at present is one which, in my opinion, is of grave concern, in view of the bad condition of the water supplies.

Building the Earth Dams at the Bridgewater Project

Three Closures of Large Storage Reservoirs Built by Sluicing Earth Fill Into Pool from Dumped Embankments

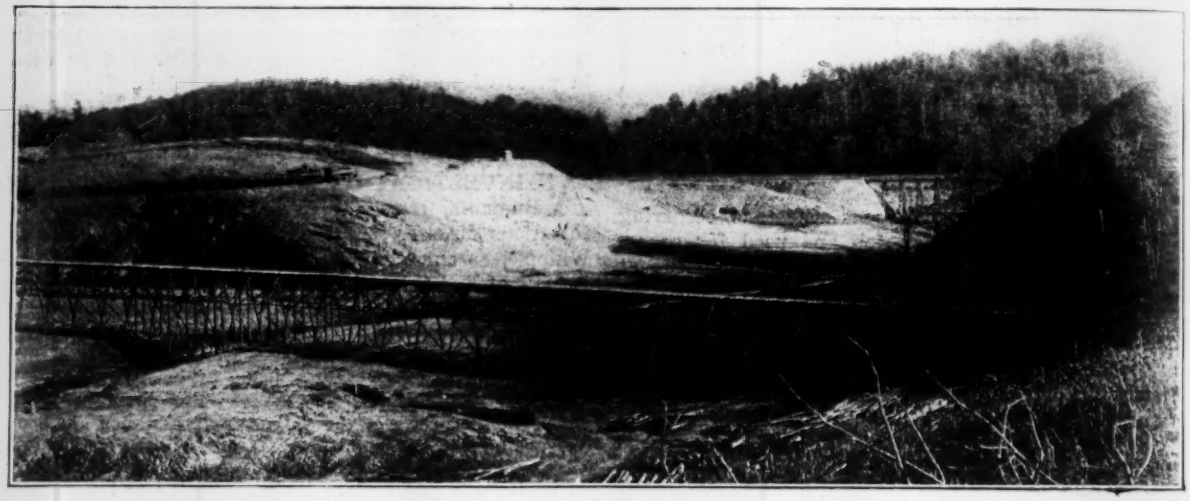
By Richard Pfaehler
Hydraulic Engineer, Western Carolina Power Co., Charlotte, N. C.

As described in the article in *Engineering News-Record*, June 3, 1920, p. 1088, the new Bridgewater reservoir for the Western Carolina Power Co. is formed by three dams, called the Catawba, Paddy Creek and Linville dams. Of these the Catawba has a gravity concrete section crossing the river, but the remainder of that dam and all of the other two are earthfills, built by hydraulic sluicing of earth brought in by trains from near-by borrow pits and deposited along the outer edges of the dam from timber trestles.

The dimensions and sections of the three earthfills are given in the previous article. They are of approximately the same design, with a 20-ft. top, upstream slopes of 1 on 3 and downstream slopes of 1 on 2½, with a central bottom trench and a downstream low rockfill toe wall. Catawba is 120 ft. high and contains about 1,820,000 cu.yd., Paddy Creek 165 ft. maximum height with 1,450,000 cu.yd., and Linville 160 ft. high with 1,250,000 cu.yd. total fill. They were located within 2½ miles of each other and the material used in building them was of essentially the same nature and composition.

Before the construction of any of the earth dams could be commenced it was necessary to unwater the dam sites, to strip the ground to be covered from all vegetable matter, to excavate a trench along the center line of each dam down to a surface of hard and impervious material and to construct a rockfill toe on the downstream side of the earthfills. While this work was going on suitable borrow pits were located containing the material used in the construction of the fills, consisting in general of disintegrated gneiss and mica schist, sand and clay intermixed with small stones. To determine the rate of seepage or frictional resistance of the various materials, a percolation testing tank was built.

Linville Dam.—To unwater the dam site, the combined flow of the Linville River and Paddy Creek diverted through the tunnel and 20 ft. diameter penstock to below the powerhouse site. To this end, penstock reducer and the 6 ft. diameter gates valves, including the bursting plate outfit, were temporarily off, and the two penstock branches leading to the power house were closed up by the 11 ft. diameter butterfly valves. This work was, however, not completed on schedule time and keeping the river flow free from any obstructions in the meantime, a dike, forming part of the upstream toe of that dam, was built on the left side of the river bank until it reached a height of 45 ft. above the normal water level. Similar work was done on the downstream side of the dam after the rockfill toe located outside of the river bed was constructed by depositing suitable stone materials excavated from the power-house foundation and the tunnel. When the tunnel and penstock were nearing completion, cribs filled with stones were placed across the river bed, and then the connection of the upstream dike with the bluff on the right river bank was made. After this work was done the dam foundation between the two dikes was unwatered. Since the river bed and the bluff consisted of gneiss built up of saw-toothed strata giving a good bond for the earthfill materials, this portion of the dam foundation was prepared by removing all debric and washing down the prepared by removing all débris and washing down the thin layer of top soil and small stones by means of a hydraulic monitor.

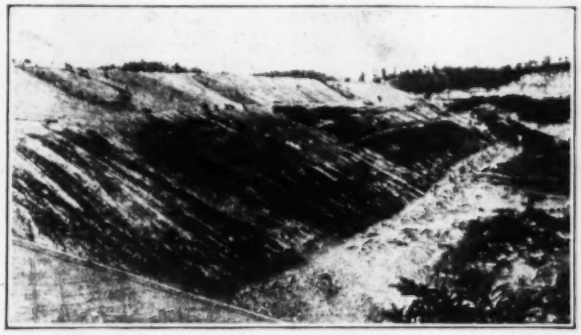


VIEW OF STRIPPED PADDY CREEK DAM FOUNDATIONS, LOOKING DOWNSTREAM

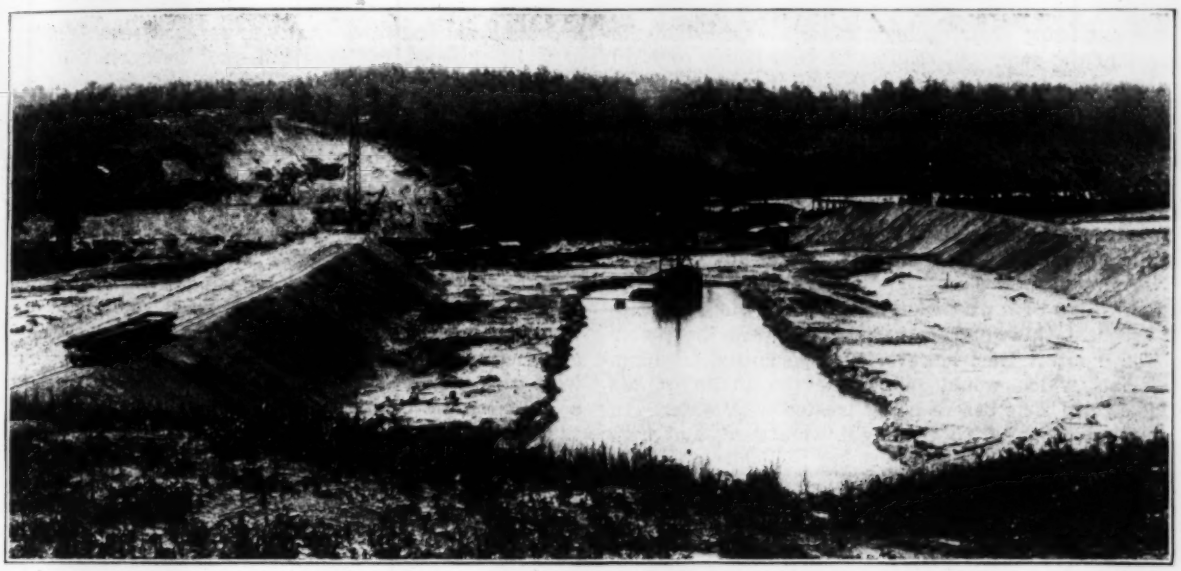
Catawba Dam.—For the trench excavation at the Catawba dam across the bottom land on the left side of the river, it was known beforehand that the silt and sand deposits, which had to be penetrated, would not permit the use of steam shovels for cutting the trench without incurring considerable expense. It was, therefore, decided to use a suction dredge, provided with a cutterhead for agitating the materials, having a capacity of 140 cu.yd. per hour. There were, however, numerous logs, brush and roots encountered which cut down the capacity of the outfit; delays were also caused by gravel and boulders clogging up the pipe. The material pumped from the water-filled trench was flumed

a point above the upstream toe of the dam and later directly into the river. After the dredging work in this portion of the trench was completed, the extension up the hillside was made by sluicing down the materials into the bottom trench by use of a hydraulic monitor, and by subsequent removal of same with the suction dredge. This work was done within a few days as rock was soon encountered.

At the time the trench excavation was progressing, cofferdams were built partially across, and along the left edge, of the Catawba riverbed, and the foundations for the 274-ft. long masonry retaining wall and the 125-ft. long finwall were prepared. The dike forming the upstream toe of the earthfill was also built to a height of 25 ft. (the top being 45 ft. above the normal water level of the Catawba River) and temporarily connected with the upstream end of the cofferdam before it could be thrown against the upstream face of the spillway masonry. Along the downstream edge of the dam, the material for the rockfill toe was placed and



DOWNSTREAM SLOPE OF CATAWBA DAM PARTLY PLANTED WITH GRASS



SUCTION DREDGE WORKING IN TRENCH AT CATAWBA DAM

the depositing of earthfill materials begun. By this method the dam foundation was protected against possible floodwater carried by the Catawba River.

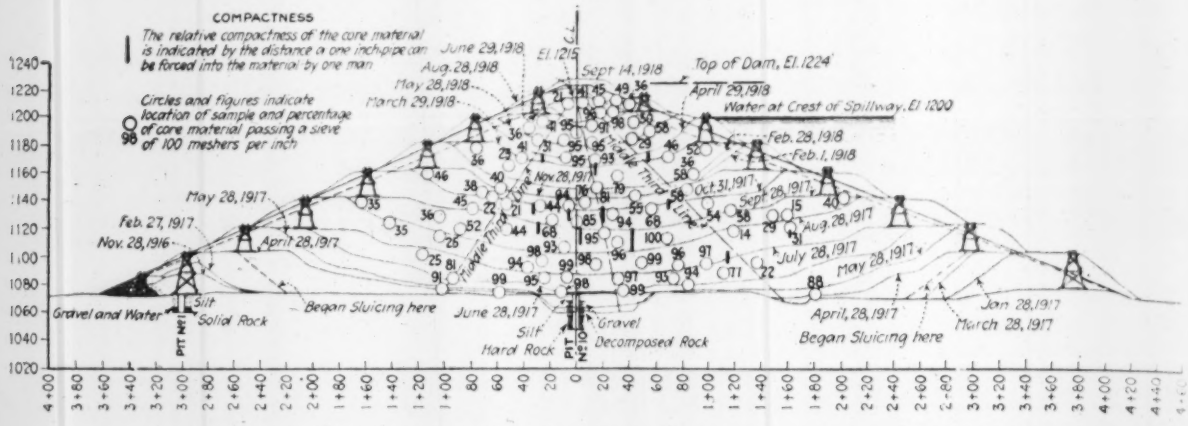
After all the sand and silt deposits were removed, the trench was unwatered and a steam shovel placed in the bottom to take out the gravel and boulder materials which the suction dredge was not able to move. Below the gravel strata decomposed rock showed up, which was excavated down to a depth of from one to two feet and the finishing of the trench was done by teams and handforces. Water was then pumped into the trench and the hydraulic sluicing of the earthfill materials begun.

Paddy Creek.—After the flow of Paddy Creek was diverted into the Linville River by excavating a channel through the ravine at the lower end of the ridge between the valleys, the excavation work for the Paddy Creek trench was commenced. This work was done by steam shovel and no difficulty was encountered.

The method of construction of the three dams above the trench excavation was essentially the same and the following description applies equally well to any of the structures. The views show the progressive stages as illustrated in the three dams; the trestle erection at Paddy Creek, the suction dredge at the low stage of Catawba and the sluicing operation at Linville. A view of the sodding at Catawba and the method of procedure at Paddy Creek, illustrated by a cross-sectional drawing, are also included.

In line with the specifications calling for the construction of the interior of the earth dams by the hydraulic sluicing method, the materials from the various borrow-pits were loaded by steam shovels into side-dump cars, made up into trains and transported by locomotives to the timber trestles, the first set of which was built along and inside the upstream and downstream toelines of each dam. From these trestles the materials were dumped and after the two dikes thus created had reached the required size the trench excavated along the center of the dam was filled with water.

Two scows equipped with pumping plants capable of delivering 1,000 gal. of water per minute at each 2-in. nozzle of the sluicing monitors were then floated in the pool formed between the two dikes. After the second



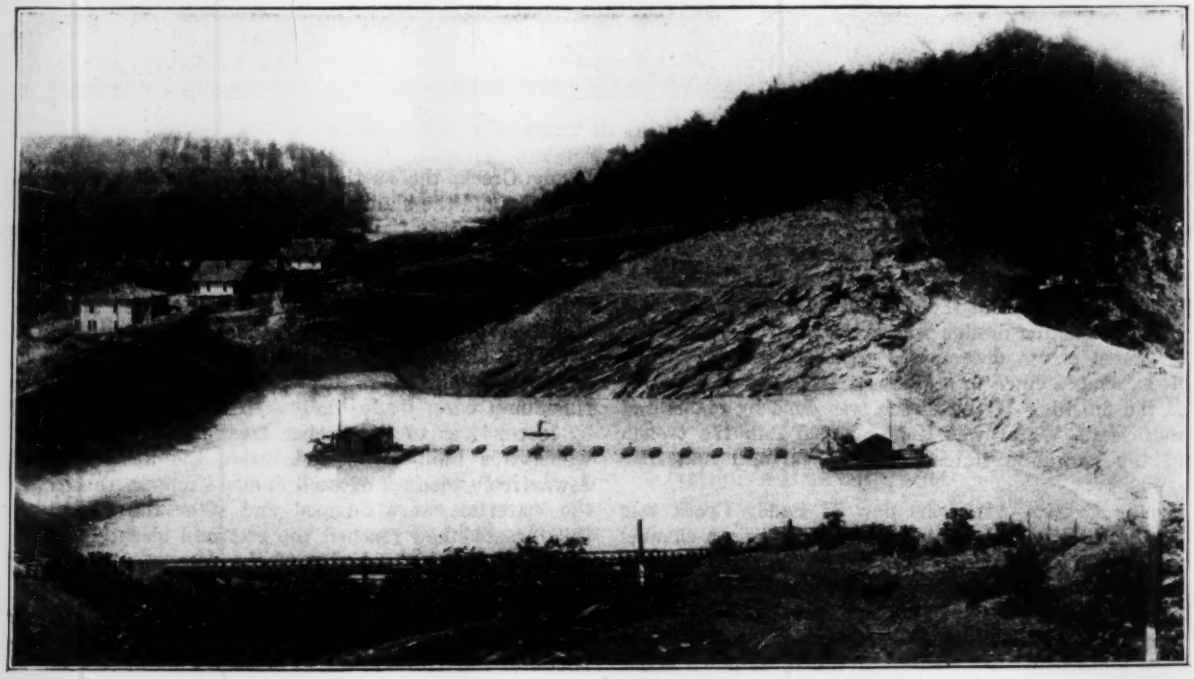
CROSS SECTION THROUGH PADDY CREEK DAM SHOWING METHOD OF CONSTRUCTION

set of trestles was built, the inner portion of the fill materials side-dumped from these trestles was mixed with water and washed down by use of the monitors, the result being that the finer materials settled in the center of the dam. As soon as beaches began to form the surface of the pool was raised by pumping in additional water. Stones which were allowed to remain in the outer third of the fill were separated from each other by earth, and any roots, logs or timber uncovered by sluicing, or floating in the pool, were removed from within the area of the dam site. Due attention was also given to the height of the pool so as to prevent sliding of the deposited materials due to any excessive water pressure.

Both dikes of a pair were advanced at the same rate by frequent throwing of the tracks toward the center of the dam; it was, however, not permitted to dump materials which would fall inside the limits of the middle-third zone before being treated with water. In general, trestles of 20 ft. height were used, and with the exception of the stringers it was not required to pull the trestle timbers. When the earthfill had reached a height which was above the spillway crest, the hydraulic sluicing was discontinued and the selected material dumped in the small pool between the two dikes. Above the highwater level of the reservoir the pool was discontinued and the dam finished to the specified height allowing for shrinkage of the earthfill materials. The grading of the side slopes was done by teams and drag scrapers. Stone riprap was placed on the water slope of the dam, and the downstream slope was planted with grass.

To determine the compactness of the materials deposited in the middle third during the construction of the dam, a 1-in. pipe plugged up at the lower end was forced into the material by one man and the depth of penetration recorded. Samples of the core material were also regularly taken, dried and passed through a 100-mesh sieve, and the degree of fineness noted.

The complete Bridgewater project was executed under



HYDRAULIC SLUICING OUTFIT IN OPERATION AT LINVILLE DAM

the direction of W. S. Lee, vice-president and chief engineer of the Southern Power Co. Albert S. Crane, of the J. G. White Engineering Corporation, was retained as consulting engineer in connection with design and construction of the earth dams and masonry structures, and F. H. Cothran was resident engineer.

Comparison of Wood Stave, Iron and Concrete Pipe

THE comparative cost, durability and efficiency of wood, concrete and cast iron for the pipe line of a proposed additional water supply for Norfolk, Va., are discussed by Dabney H. Maury, consulting engineer, Chicago, in a report recommending a supply from Lake Prince. On this 20-mile pipe line the soil and other local conditions will vary so that no one material will be the best for the entire distance.

In first cost, wood stave pipe is shown to be by far the lowest. For a given diameter and pressure the ratios for wood, reinforced concrete and cast iron are 1, 1.7 and 2.4 respectively. In carrying capacity, the wood and concrete pipe are about equal and the capacity would be maintained throughout their life, as neither material would have the inner surface affected by the acids in the local waters. It is estimated that the capacity in either case would exceed that of cast-iron pipe by 20 per cent at the outset. Further, the report states that owing to the rapid formation of tubercles of rust in cast-iron pipe by the corrosive action of the local waters, this difference would increase probably to 40 or 50 per cent within 15 or 20 years.

Leakage to a small amount will be unavoidable with any kind of pipe. It is estimated that each 100 gal. of leakage per 24 hours per inch of diameter and per mile of pipe that must be provided for will add about $1 per lineal foot to the first cost of the pipe line. It is assumed that the leakage of wood stave pipe would exceed that of concrete or iron by 100 gal. per 24 hours per inch per mile, thus adding $1 per foot to the cost. In durability, wood stave pipe is expected to give a life of at least 30 years, the clayey soil along the Norfolk line being favorable to the preservation of the steel bands. Although the life of cast-iron pipe is commonly estimated at 80 to 100 years, the report puts it at 60 years under the conditions at Norfolk "because of the known fact that cast-iron pipe is affected rapidly by the local waters." For concrete pipe a life of 60 years is assumed, in view of the short periods of experience with this pipe under such conditions as exist at Norfolk.

A strong local prejudice in Norfolk against wood stave pipe is noted in the report, this prejudice being based on experience with a 24-in. pipe of the Norfolk County Water Co. It is explained, however, that this pipe is of pine (instead of redwood or fir) and is machine banded in short lengths instead of being continuous stave pipe, which would be used in the new pipe line. Although this existing pipe is leaky it is said that the wood is sound and that the bands are in good condition.

Comparative Cost of Pipe

The first cost of 36-in. wood stave, concrete and cast-iron pipe for 100 ft. head, laid complete, but without allowance for engineering and contingencies, is given as $8.60, $15.25 and $20.50 per lineal foot, respectively. The relatively small carrying capacity of the iron pipe per inch of diameter is stated to add 40 per cent to its actual first cost, making this $28.70 instead of $20.50. The assumed greater leakage of wood stave pipe adds $1 to its first cost, making $9.60.

Taking the life at 30 years for wood stave pipe and 60 years for concrete and cast iron, the first would have to be charged with the cost of one complete renewal. The present value of $9.60 due 30 years hence, with interest compounded annually at 4½ per cent, is $9.60 x $0.267 or $2.56. With this additional charge for renewal the first cost of wood stave pipe in comparison with concrete and iron would be $12.16. Thus the final comparison of first cost on an equivalent basis would be $12.16 per lineal foot for wood stave pipe, $15.25 for concrete and $28.70 for cast iron.

As an alternative comparison, the report assumes a life of 25 years for wood stave pipe and 90 years for the other materials. In this case the figures are $14.04, $15.25 and $28.70. Even under these conditions, says Mr. Maury, it would be more economical to use the wood stave pipe wherever the conditions are favorable to its durability and to use cast-iron pipe only where it is impracticable to use either the wood stave or the concrete pipe. From the surveys it is estimated that the supply main would be composed of 58,000 ft. of wood stave pipe, 25,000 ft. of reinforced-concrete pipe and 17,700 ft. of cast-iron pipe.

New York Zoning Ordinance Upheld

THE New York State Court of Appeals has upheld the constitutionality of the zoning regulations adopted in 1916 by the New York City Board of Estimate and Apportionment. The case arose through an action brought by the Lincoln Trust Co. against the Williams Building Co. to secure cancellation of a land purchase contract on the ground that owing to the zoning regulations an unencumbered title could not be given. The court holds that both parties ought to have known of the regulations and that the property under contract was not encumbered because the use to which it can be put is limited by its location in a residence district. A portion of the opinion follows:

In a great metropolis like New York, in which the public health, welfare, convenience and common good are to be considered, I am of the opinion that the resolution was not an incumbrance, since it was a proper exercise of the police power. The exercise of such power, within constitutional limitations, depends largely upon the discretion and good judgment of the municipal authorities, with which the courts are reluctant to interfere. The conduct of an individual and the use of his property may be regulated.

The resolution in question simply regulates the use of property in the districts affected. It does not discriminate between owners. It is applicable to all alike. Therefore the general and wellnigh universal rule should be applied, viz.: That where a person agrees to purchase real estate which at the time is restricted by laws or ordinances he will be deemed to have entered into the contract subject to the same. He cannot thereafter be heard to object to taking the title because of such restrictions. (Bennett vs. Buchan, 76 N. Y. 386.)

The contract was deliberately entered into. It is not claimed that defendant was misled, deceived or improperly influenced in making it. The situation, so far as the resolution in question is concerned, was precisely the same when the deed was to be delivered as when the contract was executed. Defendant was not buying the property for a particular purpose.

Need for Sub-Grade Study Evidenced in Road Upheavals

New Jersey Experience with Asphalt Type Stresses Necessity for Adequate Drainage—Concrete Base Resists Frost Action

FAILURES in so-called durable types of highway surfacing were frequently noted in the Middle Atlantic and New England states during the spring thaw this year, and highways, especially those of bituminous types, which were thought to have but begun useful lives, became almost impassable because of numerous "blowups." Failures have been of such a character as to necessitate examination of all the details of construction in the effort to determine whether poor construction methods, poor materials, increased traffic, or inadequate

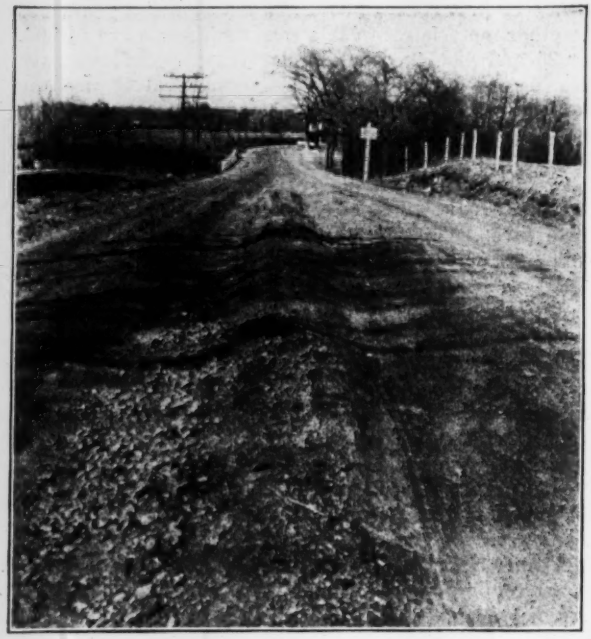


FIG. 1. A 50-FOOT LENGTH BLOWN UP FROM THE CENTER

drainage have been responsible for the failures; or whether it is a combination of any two, or all of these factors entering into the construction of weak pavement. Engineers who have studied the situation thoroughly, however, appear to agree that the inadequacy of subsurface drainage is the chief contributing factor to road failures.

During the past few months, travelers over that part of the New Jersey State Highway known as State Route No. 1, between New Brunswick and Trenton, which is a part of the main New York-Philadelphia road, have experienced at least the inconvenience of traversing a road badly "blown up" by frost action. Traveling from New York this spring, one left a new concrete road at Metuchen to enter upon stretches of bituminous types that grew extremely bad just south of New Brunswick and continued beyond Cranbury. From this point, however, a smooth, unimpaired surface, also bituminous, stretched on to Trenton.

Examination of the details in the construction of these good and bad sections of State Route No. 1—that in Mercer County and that section in Middlesex County —offers an excellent comparison between two type bituminous surfaces laid upon practically the s foundation and with apparently slight difference in composition of the subsoil, and indicates clearly to highway engineer the care which he must employ designing drainage structures for heavily trave highways.

Both of these sections of highway are of comparati

FIG. 2. TREE SHADOWS INDICATE SURFACE IRREGULARITIES

recent construction. That portion in Middlesex County, known as the Cranbury Turnpike, was constructed in 1917 in four sections as follews: Section 1, New Brunswick city line to Black Horse Inn; Section 2, Black Horse Inn to the Dayton R. R.; Section 3, Dayton R. R. to Plainsboro Road, Cranbury; Section 4, Plainsboro Road, Cranbury, to the Mercer County line. A 2-in. Warrenite surfacing with a squeegee coat was laid upon the reconstructed waterbound macadam base, which was scarified and brought to a uniform thickness of 6 in. and a uniform width of 18 ft. The standard New Jersey specifications for macadam and Warrenite were followed in the construction of this section, and the work was done under the extraordinary repair act permitting reconstruction to existing grades and line. The original macadam was a very old pavement and not laid to any definite grade, a fact accounting for the present irregular profile. In general there were added to the old macadam 3 or 4 in. when compacted, of 1½-in stone. The old macadam road was in many places but 16 ft. wide, and where widened the base was built to a depth of 8 in., as were also the 2-ft. shoulders.

In accordance with the specifications ditches were constructed to provide for the unobstructed flow of surface water. At places where previous trouble had been experienced in maintaining the macadam foundation, a concrete base was constructed, and where there was any indication of trouble from subsurface water a 4-in. porous tile, covered with stone and laid approximately 3 ft. below the finished grade, was installed, either herring-bone fashion to the side ditches or longitudinally to the nearest cross stream. Several sections of this Warrenite topping were laid upon concrete bases and that portion of the road through the village of Cranbury was entirely constructed upon a 6-in. concrete base.

The Mercer County section of this State Route No. 1, known as Nottingham Way, was built in 1916 by the county, though the state furnished the laboratory in-

spection of materials. It is constructed of a 2-in. Topeka surface with a squeegee coat upon a 6-in. macadam base. The old macadam road was widened from 16 to 18 ft., scarified and thoroughly rolled to give a compact base. The standard New Jersey specifications for the laying of a Topeka mixture were followed, though the state did not participate in the construction, the forms being simply adapted to county requirements.

FIG. 3. SECTION ENTIRELY DISINTEGRATED—NOTE SURFACED STRIP ALONG ROCK SHOULDER

The asphalt used in the mixture was a Mexican product. The section between Mercerville and Robbinsville was provided with French drains where there were indications of spongy or bad subsoil conditions. French drains were constructed by using a 4-in. porous tile laid on hemlock boards 6 in. wide. Trenches for the drains were approximately 36 in. below the finished grade, were 15 in. wide and were filled with 2½-in. broken stone up to within a few inches of the sub-base. At this point the broken stone was covered with salt hay and then covered with a few inches of pervious soil.

Both the Cranbury Turnpike and the Nottingham Way, being adjoining sections of State Route No. 1, carry the same heavy commercial and passenger motor vehicle traffic from New York to Philadelphia.

All four sections of the Cranbury Turnpike showed bad blow-ups during the spring thaw, while Nottingham Way seemed to have suffered not at all from the severe winter. The first section of the Cranbury Turnpike was the worst. Blow-ups in the surface began by the appearance of slight longitudinal corrugations which became larger and more pronounced under the intensive traffic and which finally cracked along the ridges and depressions, admitting moisture. The surfacing then shredded under traffic and in some instances was little better than a poorly maintained waterbound macadam.

Examination of the details of the construction of these two sections revealed, therefore, that they were built with little variation either in design or construction methods employed. The traffic upon them was exactly the same. The question immediately arose, then, why should one section fail and the other show no ill effects whatever from the severe winter? The answer evidently was either in a further examination of subsoil conditions and the design of subsurface drainage structures or the care exercised during construction. Inasmuch as the pavements were duly accepted upon construction, and engineering inspection was furnished by the county, it is presumed that the construction methods employed were satisfactory. The answer, therefore, seemed to be in investigating further the subsoil conditions.

In this examination two facts were outstanding: (1) That the French drains sufficed for the Mercer County section of the highway, yet did not for the Middlesex County section; and, (2) where the Warrenite surfacing was laid upon a concrete base of adequate thickness, no failures were noted, the shining example of this type of construction being through the village of Cranbury.

Though cursory examination would indicate that the subsoil underlying the macadam bases of these two sections of highway was of the same character, a close inspection proved the contrary. In the Mercer County section or on Nottingham Way the subsoil conditions were excellent, the subsoil nearest Trenton being of

FIG. 4. WHAT THE FROSTS DID TO SIDE DITCHES

sand offering the best sort of natural vertical drainage. From such a sandy material the subsoil, north from Trenton, changes to a sand-loam mixture, which, farther on, becomes less pervious through its admixture with a stiff clay. Upon passing into Middlesex County and upon encountering those portions of the state highway that have blown up badly, the subsoil is mostly clay with some portions of a clay-loam mixture. To this difference, then, in natural vertical drainage is attributed the success and failure of the French drains to protect the Topeka and Warrenite surfacings from disintegration through a combination of heavy frost action and intensive motor vehicle traffic. In some places where bad blowouts had occured inhabitants living along the highway who had known the history of the road even before waterbound macadam had been laid asserted that those parts had been quagmires, practically impassable during the winter season. Numerous replacements have been made along Nottingham Way since its construction, though the most serious failure in its entire history occurred this spring.

In constructing the concrete section extending from Rahway to Metuchen, built last year by the New Jersey State Highway Department, what some engineers may consider too careful attention to subsurface drainage was made. Besides the side ditching—which, in cuts is provided for by an integral curb gutter—to care for the surface water, a line of 4-in. open joint tile was laid on either side of the road at a depth averaging 42 in. below the finished surface. Lampholes of the

same diameter were provided at every few hundred feet. Broken stone covers the tiling up to the sub-base, and such a drainage structure has formed a cut-off wall, which effectively protected the concrete pavement from any injury during the heavy winter. Only one or two longitudinal cracks appeared in the surface in the entire 12-mi. length.

Though the State of New Jersey has taken over Cranbury Turnpike constructed by Middlesex County as part of the state highway the expensive replacements necessary through the recent blowups are taken care of by the contractors' five-year guarantee which does not expire until the summer of 1922.

Several photographs showing road blowups along Cranbury Turnpike are reproduced herewith.

Contractors Enunciate Principles of Employment Relations

RECOGNITION of the facts that the public interest is of prime importance, and that mutuality of interest between employer and employee is the only solid basis underlying industrial relations, is the salient point in the statement of fundamental principles governing employment relations recently enunciated by the Committe on Labor of the Associated General Contractors of America. In presenting the report embodying the statement of principles, the Committee on Labor asserts through publication of the report in the Association's Bulletin, that the interests of employers, employees, and investors, as well as the public interest, must be defined and protected and to this end public opinion be kept informed and enlightened. The first step toward industrial peace, continues the report, will be "a realization of the interdependence of all elements related to industry, and a recognition of the responsibility one to another."

The eleven principles which are closely patterned after the statement of principles recently enunciated by the Chamber of Commerce of the United States, and which are only tentative and may be amplified by general discussion, are given herewith:

(1) *The Employment Relation.* Every person possesses the right to engage in any lawful business or occupation and to enter, individually or collectively, into any lawful contract of employment, either as employer or employee.

(2) *The Open Shop.* The right of employer and employee to enter into and to determine the conditions of employment relations with each other (without reference to the affiliation or non-affiliation of either with any organization) is an individual right of free contract possessed by each of the parties.

(3) *Right of Association.* All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means. The association of men, whether employers, employees, or others, for collective action or dealings, confers no authority over and must not deny any right of those who do not desire to act or deal with them.

(4) *Responsibility of Combination.* The public welfare, the protection of the individual, and sound employment relations equally require all associations or combinations to be subject to the authority of the state. As the public interest is paramount, full publicity of facts of industrial relations is necessary.

(5) *Obligation to Secure Production.* To develop, with due regard for the health, safety and well-being of the individual, the maximum capacity and output required of the industry is the common social obligation of all engaged therein.

(6) *Wages and Management.* The wage of labor [illegible] be drawn from the conduct of industry and must there[illegible] be earned and measured by its contribution to produc[illegible] All employees are entitled to complete business informa[illegible] in matters affecting the terms of their employment; frankness is essential. In order that the worker, in own and the general interest, may develop his full pro[illegible] tion capacity, it is the duty of the management to a[illegible] him to secure regular employment suited to his ability, furnish him with incentive and opportunity for self[illegible] provement, and to provide proper safeguard for his he[illegible] and safety.

(7) *Hours of Labor.* The number of hours in the wo[illegible] ing day or week in which required maximum output, co[illegible] sistent with the wellbeing of the workers, can be maintain[illegible] in a given industry, should be ascertained by careful stud[illegible] and never should be exceeded except in case of emergency. One day of rest in seven, or its equivalent, should b[illegible] provided.

(8) *Adjustment of Employment Relations.* Adequate means satisfactory both to the employer and to his employees, and voluntarily agreed to by them, should be provided for mutual discussion and adjustment of employment relations.

(9) *Community of Interests.* The greatest measure of reward and wellbeing for both employer and employee, and the full social value of their value to the public must be sought in the successful conduct and full development of the industrial establishment in which they are associated. Intelligent and practical co-operation based upon a mutual recognition of this community of interest constitutes the true basis of sound industrial relations.

(10) *Government Employment.* The state is sovereign and cannot tolerate a divided allegiance on the part of its officers and servants. While the right of government employees, national, state or municipal, to be heard and to secure consideration and just treatment should be amply safeguarded, the community welfare demands that no combination shall be permitted to prevent or impair the operation of government or of any governmental function.

(11) *Public Service Employment.* In public service activities, the public interest and wellbeing must be the paramount and controlling consideration. The power of regulation and protection exercised by the state over the corporations should properly extend to the employees in so far as may be necessary to assure the adequate continuous and unimpaired operation of public utility service.

The chairman of the Committee on Labor of the Associated General Contractors submitting this statement of principles is Leonard C. Wason, of the Aberthaw Construction Co., Boston, Mass.

Shortage in Building Construction

According to a bulletin recently issued by the Guaranty Trust Co., of New York, the shortage in building construction at the end of the year, 1919, was one and one-third times a normal year's building. Such a conclusion was arrived at by comparison of building permits for from 143 to 151 cities in the United States covering the years 1913 to 1919 inclusive, figures which were compiled by the United States Geological Survey. The value of building permits upon which the calculations are based are as follows: 1913, $859,657,250; 1914, $785,525,746; 1915, $799,735,860; 1916, $1,024,211,675; 1917, $687,415,605; 1918, $430,014,365; 1919, $1,281,000,000.

These calculations are based upon the assumption that 1913 was a normal year. The value of building permits during 1917, 1918, and 1919, corrected by applying the index numbers for those respective years, and referred to the value of building permits in 1913, show an accumulated deficit of 134 per cent.

Building Operations by Federal Reserve Districts

THE Federal Reserve Board, in its review of general business conditions during July, has the following to say regarding building operations:

There appears to be no difference of opinion concerning the causes that are responsible for the difficulties that hamper building operations. The hindrances are summed up under the all-inclusive heads of high prices of structural materials and heavy labor costs; transportation troubles that make the securing of supplies problematical; and inability to obtain funds for financing contemplated projects, especially residential structures. It is true that, although all these factors are operative, reports from certain districts are inclined to stress some one factor while minimizing the importance of others. The situation in the west and southwest appears to be much more favorable than in other parts of the Country, Districts 11 (Dallas) and 12 (San Francisco) both reporting increased activity in the month of June as compared with May.

District 1 (Boston) emphasizes the shortage of lumber and other structural materials resulting from congested traffic conditions, and predicts that prices will remain high, probably into the spring of 1921. However, the total value of building permits in 13 principal cities outside Boston showed an increase of 47.1 per cent in amount for the first six months of 1920, as compared with the same period in 1919, although the actual number of permits declined from 3,614 to 3,440.

District 2 (New York) thinks that the principal deterrent to the execution of housing programs is scarcity of mortgage money, the New York situation being made worse by the fact that industrial projects have secured the limited amount of labor and materials available. District 4 (Cleveland), although stating that there has been some improvement in securing raw materials, especially cement, through the use of lake vessels, says that building operations are very low for the season and the outlook for the fall is uncertain. In District 5 (Richmond) no improvement is noted—a decrease in value of permits issued as compared with May is recorded. As for building materials, it becomes increasingly difficult to secure them and a number of lumber mills have shut down because of inability to make deliveries, while cement, crushed stone, steel, brick, etc., are practically impossible of acquisition. Cessation of construction in Richmond is threatened unless the local situation is relieved. In District 6 (Atlanta) on the other hand, there has been an increase in the value of permits in some of the large cities such as Atlanta, Augusta, Savannah and Mobile. A marked drop in the total volume of building permits in New Orleans was no doubt the result of the local carpenters' strike.

In District 8 (St. Louis) as a result of better weather and improvement in transportation, work already begun has been resumed or continued, but new projects are few. There is no improvement in the housing situation. Labor troubles have also been experienced. Both in the Minneapolis and Kansas City Districts the June reports show a reduction in building permits by number and value as compared with May.

In District 11 (Dallas), on the other hand, improvement has occurred in June, an increase of 15 per cent in total valuations over the month of May being noted, although the total is 16 per cent below the record for June a year ago. For the first six months of the year, the 1920 valuations exceeded those of 1919 by 147 per cent. Similarly in District 12 (San Francisco) building is inactive, permits issued in 19 cities showing valuation increases of 7.7 per cent as compared with May, and 63.3 per cent as compared with June a year ago. For the six month period an increase of 107.17 per cent was recorded.

City Planning Commission at Los Angeles

A City Planning Commission of 51 men and women has been created by the City Council of Los Angeles, California.

Reclaiming the Mines at Lens

Work is now in progress at Lens, France, on the reclamation of the coal mines. The destroyed shafts through which water found entrance to the mines are being sealed by forcing cement through a ring of bore holes around each of the damaged shafts. At two shafts the work had been completed on June 22, work was in progress at four shafts, and at the four remaining shafts requiring treatment work had not been begun. Such was the progress, however, that it was hoped that pumping could be begun in a month's time.

The coal at Lens is overlaid with several strata, one of which, of limestone, 100 m. thick, is fissured and waterbearing. The top of this stratum is about 30 m. below the ground surface and through the entire depth of the limestone the shafts were lined with cast-iron plates. There are about 30 shafts in all, 14 for the extraction of coal and 16 for ventilation, all measuring 4.8 m. in diameter. At 10 of these the Germans had dynamited the lining, thus permitting the water to flow in and fill the mines.

To reclaim the damaged shafts a ring of holes, 15 in number, placed on the circumference of a circle 15 m. in diameter is bored concentrically with the shaft. The holes go to the impervious stratum underlying the limestone, and cement grout is pumped into them under a pressure of 5 to 10 kg. per square centimeter (71 to 142 lb. per square inch.) As a rule neat cement is used, though when the flow of cement is free cement-sand grout is used until the sealing has commenced. Experience thus far indicates that about 4500 bbl. of cement will be required to seal each of the ten shafts.

It was expected that the extraction of coal would begin in about 6 months (from June 22) but full capacity will probably not be reached in less than two years. In other words, capacity operation is not expected until at least 3½ years after the signing of the Armistice.

About 1500 men are engaged on the reclamation work, contrasted with the 15,000 employed when the mines were in full operation. E. J. M.

Standing Timber in the United States

According to figures compiled by the U. S. Forest Service the standing timber in the United States in June, 1920, was distributed by species and geographically as follows:

BY SPECIES

	M ft.
Douglas Fir	595,505,000
Southern Yellow Pine	257,691,000
Western Yellow Pine	249,578,000
Oak	157,372,000
Birch, Beech and Maple	90,784,000
Other hardwoods	211,519,000
Western Hemlock	95,092,000
True Firs	91,349,000
Redwood	72,208,000
Western White Pine and Sugar Pine	57,071,000
Western Red Cedar	53,348,000
Spruce (western)	39,822,000
Spruce and Fir (eastern)	31,572,000
Other Conifers	211,982,000
Total	2,214,893,000

BY SECTIONS

New England	49,799,000
Middle Atlantic	44,857,000
Lake	110,110,000
Central	144,470,000
So. Atlantic and East Gulf	220,577,000
Lower Mississippi	280,908,000
Rocky Mountain	223,141,000
Pacific Coast	1,141,031,000
Total	2,214,893,000

Leaking Subway Station Successfully Grouted

Inflow of More Than 150 Gallons Per Minute Through Broken Joints in Waterproofing Checked By Grout Injection Through Pipes Tapping the Leaking Points

By M. H. Freeman
Resident Engineer, New York and New Jersey Bridge and Tunnel Commissions, New York City

EXTENSIVE leakage of groundwater through the roof and walls of a low-level subway station in New York City presented a very perplexing problem to the engineers of the Public Service Commission two years ago. Pressure grouting proved effective in stopping the leakage, though a seven-months campaign of cut-and-try working was needed to accomplish this result. On account of the unusual character of the problem solved, the difficulty involved in making an overhead joint with plastic waterproofing material, and the value of the experiences gained in the grouting, a comprehensive statement of the enterprise is given here.

The Canal Street-Broadway subway station is a group of four stations, three of which extend north-south in three parallel streets (Centre St., Lafayette St. and Broadway), while the fourth extends east and west in Canal St., underlying and connecting the other three. The general layout of these stations with their connecting stairways is shown in Fig. 1. The station in Centre St. (which is the Canal St. station of the Centre St. Loop subway) and the station in Lafayette St. (the Canal St. station of the original subway, now the east-side Interborough subway) have been in service for a number of years, the latter since 1905 and the former since 1911. The station under Broadway, including both upper and lower levels, was built during the years 1912 to 1915, and the transverse connecting station in Canal St., passing under the others, during the years 1914 to 1917; the construction of the latter has been described in the April 3, 1919, issue of *Engineering News-Record*.

During the construction of the two last-mentioned stations the groundwater was lowered by pumping 37 ft. below its normal level (El. 102.0), to the subgrade of the lower station, thus permitting excavation in fairly dry sand and gravel—the material which formed the bed of the old canal that once occupied the site of this street. Lowering the water level involved continuous pumping of from 6,000 to 7,000 gal. per minute. About six months after the station was finished and pumping of groundwater stopped, leaks appeared in the stairways connecting the two levels under Centre St. and later at the joint between the old and the new stations under Lafayette St. These leaks finally developed into a total inflow of 155 gal. per min.

The dead air spaces and the hollow tile of the station finish often carried this water some distance from the source of leakage before it broke through to the platforms and stairways, giving the appearance of a more general leakage throughout the station structure than actually existed. Metal pans were placed under roof drips, and channels were cut at the sides of the passageways and stairs, to collect and drain this water to the track invert, through which it flowed to the sump and pumping station. By this means the platforms, stairs and passageways of the lower station were maintained in condition for traffic. However, it was urgently necessary to undertake the earliest possible repair of the leaking structure.

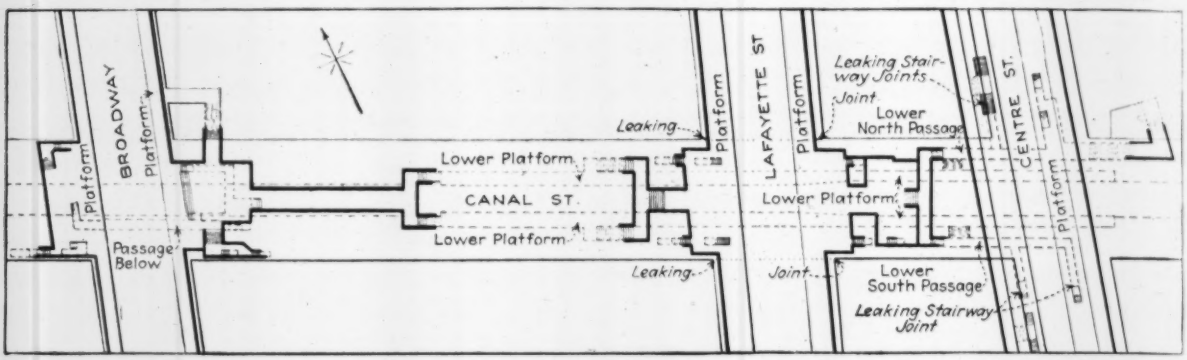


FIG. 1. GENERAL PLAN OF FOUR-UNIT SUBWAY STATION AT CANAL ST., NEW YORK CITY (BROADWAY TO LAFAYETTE ST.)

The waterproofing of the old Centre St. structure consisted of a 5-in. course of brick and asphalt mastic, laid upon a floor of concrete about 6 in. thick, as shown in Fig. 2. Over the piles supporting the steel girders sheet lead was inserted, and was bonded in at both ends between the two courses of the brick and mastic. The waterproofing of the newer structure was of similar material, a 5-in. layer of brick and mastic on horizontal surfaces, an 8-in. layer on vertical walls. Where openings for stair wells were cut through the floor of the upper station the brick and mastic of the lower structure was brought up and joined to the old work as shown in Section c-c, Fig. 2. This new vertical wall of waterproofing possibly settled from its junction with the old waterproofing, or possibly the mastic was squeezed out of the brick by groundwater pressure and pushed over the top of the new 3-ft. concrete wall of the stairwell. This wall, though it was built on undisturbed material, had evidently settled slightly from the overhead structure supported by piles, for when the station finish was removed the joint was found to be open about ½-in. and to be the source of considerable leakage.

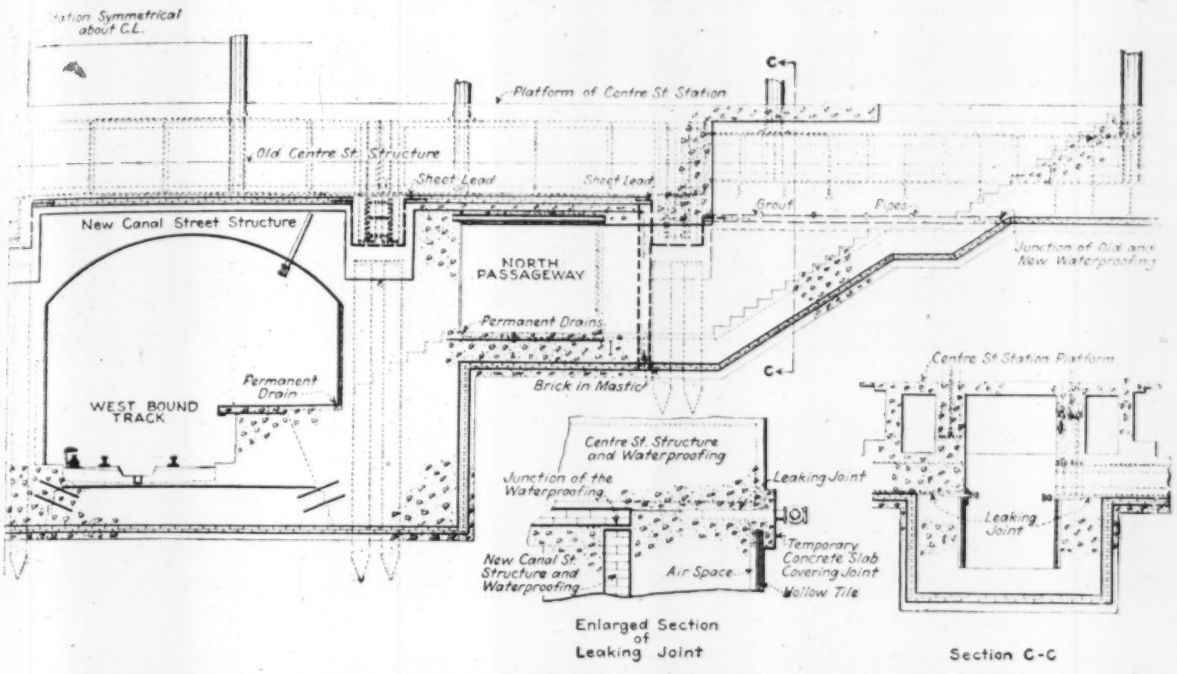


FIG. 2. WATERFROOFING AT STAIRWAY JOINTS—NORTH-SOUTH SECTION ALONG CENTRE ST.

The floor waterproofing of the Interborough station in Lafayette St. also consisted of a 5-in. layer of brick and mastic resting upon a 6-in. concrete bed. A 6-in. layer of crushed stone on which the concrete had been deposited had later been removed, when the excavation for the underlying station was made. The waterproofing of the lower structure was similar to that under Centre St. but was brought up to a special junction with the overlying waterproofing (see Fig. 3). The 6-in. floor of concrete under the Interborough waterproofing was channeled out along the joint with the lower station, and the junction of waterproofing was made in this channel. A two-ply fabric coated with coal-tar pitch was placed against the outside wall of the lower structure and carried up and lapped under the overhead brick and mastic of the upper structure, in which position it was held by a longitudinal timber braced from the girders below. Inside of this fabric, allowing a space of 1½ in., a brick wall laid in cement mortar was built up and joined to the overhead structure. The 1½-in. space was then poured full of hot mastic, repouring as the mastic settled until the space was completely filled. This joint was not exposed, but holes drilled to it opened up such an inflow of water as to leave little doubt about a break in the waterproofing.

It is to be noticed that while the leaks occurred along the main wall under Lafayette St., they occurred principally in the stairways under Centre St. and not along the main wall. At the latter point the wall did not have an overhead junction of waterproofing but the brick and mastic were brought up beside the sheet lead that covered the pile caps of the old structure (as at right in Fig. 2); thus the waterproofing of the lower structure could settle without breaking contact with the lead. The method of waterproofing has been outlined, in considerable detail in order to show its substantial nature, and the effort made to secure a tight overhead joint, at this difficult point.

Early observations brought out many different ideas as to the cause of the leaks (many believed the joints to be intact) but as time passed conditions pointed more and more to the above-mentioned joints. Different methods of attacking the problem were considered. From the first, it was apparent that it would be much less expensive to work from the inside than to expose the outside of the structure, and it was finally decided to try plugging the breaks in the waterproofing with portland cement grout injected from the interior of the station. Early attempts to do this were so successful as to lead to the conclusion that this method would prove effective throughout. Arrangements were therefore made to go ahead with the work as fast as could be done without hampering train operation.

Experiments with Grouting—Work was begun Oct. 3, 1918, in the west stairway leading from Centre St. Loop to the north passage in Canal St. (see Fig. 1). The joint at this stairway was chosen for a trial because the leak was somewhat isolated from the others, and thus afforded a chance to test the pumps and other equipment and get the men accustomed to the work, in a place where the grout could not travel long distances; long travel of the grout would have involved the handling and injection of a considerable quantity of cement, and the work would have had to be conducted in continuous shifts of workmen. The station finish was removed, exposing an open joint between the old and new concrete about ¼ in. wide, through which a flow of 45 gal. per min. came in. Four holes 18 in. deep, spaced approximately 4 ft. apart, were drilled into this crack on each side of the stairway, and 2-in. pipes were set for grouting. The crack between pipes was then caulked with oakum and lead wool, forcing the incoming water through the pipes.

Grout was injected with a No. 2 Douglass hand pump equipped with a gage to register grouting pressures; a Gould pump was used to supplement the Douglass

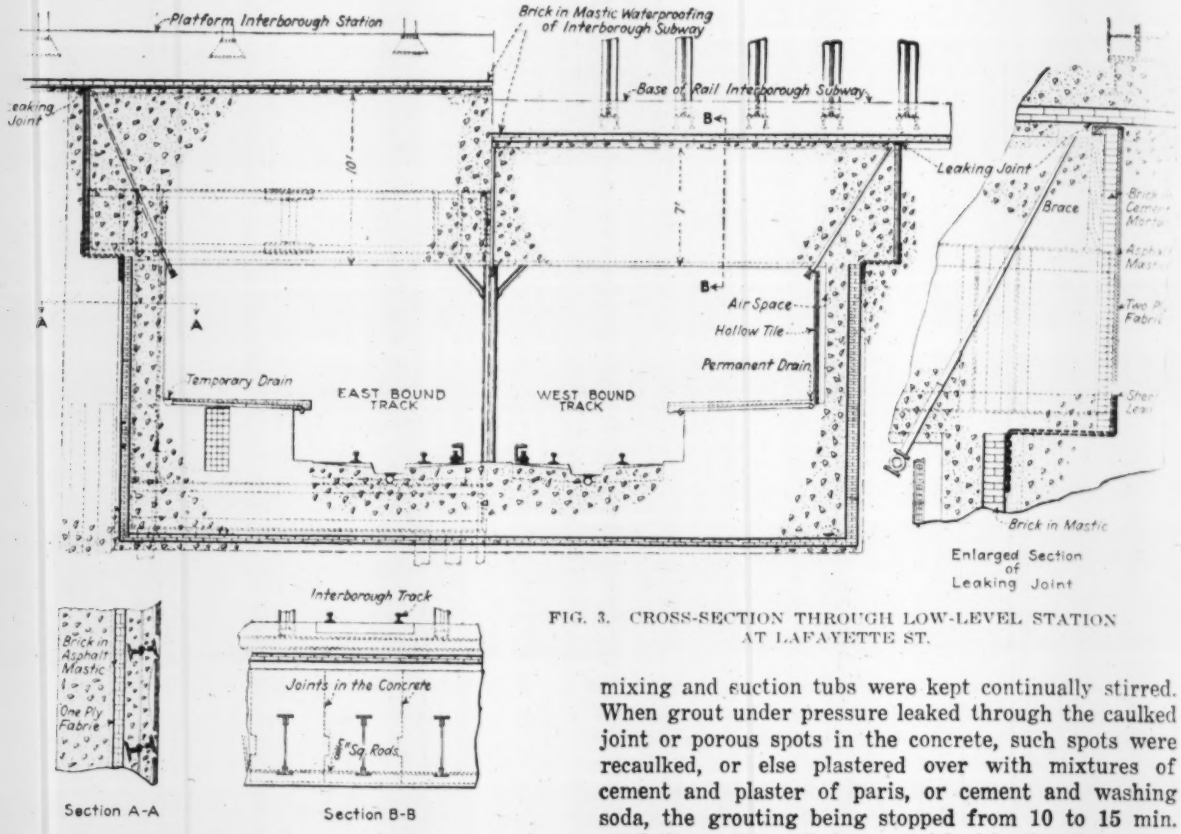


FIG. 3. CROSS-SECTION THROUGH LOW-LEVEL STATION AT LAFAYETTE ST.

pump whenever it was necessary to repack cylinders or renew valves. The grout was mixed by stirring with a paddle in one tub and bailed to another, from which it was pumped. After placing valves on all pipes, connection was made to one, and thin grout (¼ bag of cement to 12 gal. of water) was injected; as soon as other pipes flowed grout their valves were closed. Several batches of the thin grout were then pumped in. if the pipe took grout readily and the grouting pressure did not rise much above the theoretical back-pressure due to groundwater head, it indicated an open grouting channel beyond the pipe, and the grout was thickened to ½ bag of cement to 12 gal. of water; if this thicker mixture went in without increase of pumping pressure, the batch was again thickened, through stages of 1, 1½ and 2 bags of cement to 12 gal. of water. The last mixture was about as thick as the pump could use without undue clogging. Just as soon as the gage on the pump indicated an increase in grouting pressure the mixture was thinned, sometimes using the thinnest mixture at once, sometimes step by step, according as the grouting pressure increased quickly or gradually. The pipe was finally closed with as thin (or thinner) mixture as that with which it had been started, and under as great a pressure as could be used without danger of lifting the overhead structure, at this particular stairway about 50 lb. per sq.in. In ordinary grouting, of course, these pressures would be by no means high.

Under this pump pressure the grout traveled in the joint distances of from 20 to 30 ft., and before the east side of the stairway was completely grouted the joint on the west side was more than half silted up. To get best fluidity of grout, bags showing any evidence of lump cement were discarded, and also the mixing and suction tubs were kept continually stirred. When grout under pressure leaked through the caulked joint or porous spots in the concrete, such spots were recaulked, or else plastered over with mixtures of cement and plaster of paris, or cement and washing soda, the grouting being stopped from 10 to 15 min. until the newly applied material had hardened.

Grouting with thin mixtures as the crack became filled with cement was in effect a silting-up process: Large quantities of water were forced through the joint into the ground outside, until the cement held in suspension silted up and clogged the channel, making a seal through which water could not be forced, at grouting pressure. The object was to make the seal so complete throughout the joint and beyond the pipe, that each pipe would be left empty and dry when grouting stopped. Such a seal was seldom actually obtained. There was usually a slight drip and the valve was closed after grouting. On the following day all pipes were cleaned out and any showing drips were regrouted.

At this joint two of the holes were drilled to a depth of 30 in. but no water was encountered. Two-inch pipes were used, not only to furnish an open channel for the grout, but to provide an opening large enough for thorough cleaning and possible redrilling of the holes whenever desired.

At the west stairway, the first working point, a total of 45 bags of cement was used and all leakage was stopped except a slight dampness most of which disappeared about one week after grouting.

Extending the Work—The two stairways on the opposite side of Canal St., leading down to the south passageway, were grouted dry in turn, and with the completion of this work the greatest part of the leakage between the upper and lower structures in Centre St. had been stopped. Setting pipes could not be done very far ahead of the grouting, as cutting away the station finish to expose the joint so increased the leakage that there was danger of overflowing the temporary drains and flooding the platforms. One pipe alone in one of the south stairways discharged 90 gal. per min.

When the Centre St. leakage had been dealt with, work of drilling to the Lafayette St. joints was started. A compressor with rated capacity of 250 cu.ft. of free air per minute was installed upon the street, and air pipes were laid to both long platforms of the lower station. Stope drills were used and 26 holes, 13 on each side of the station, spaced about 10 ft. apart along the edge of the ceiling, were drilled toward the joint in the waterproofing. Besides the opening along this joint it seemed probable from the distribution of the roof leaks that there was some unfilled space between the two structures, for which reason holes were also drilled in the center betwen columns, where there was sufficient room to do the work without interference with trains (see Fig. 3). In the process of drilling these holes, when the drill broke through into the waterbearing channel, a stream came from the hole that temporarily flooded the station platform. In order to have this flow under immediate control, the pipe was set and caulked after the starting drill was withdrawn, and drilling was continued through the pipe. When water was encountered the drill was withdrawn, a valve screwed to the pipe and closed.

Air and Hand Grouting—It was planned to fill this cavity at one continuous operation, following up while the cement was still soft by forcing thick grout through the broken waterproofing. Later the joint pipes would be opened and thin grout used to silt up any unfilled spaces. Anticipating that more grout would be used than could be properly handled by hand pumps, four air grout machines supplied with power by the compressor on the street were set up, two on each platform. In general the work was carried out as planned except that the overhead space was so large that it could not be filled between rush-hour periods, and continuous shifts could not be arranged on account of the necessity for keeping the platforms entirely free for rush-hour traffic.

A total of 3,138 bags of cement was injected between the two structures as thick grout, and an additional 261 bags was squeezed into the joint along the sides afterward. The squeezing process was repeated a number of times at each pipe, covering a period of several days. The hand pump was used for this purpose, as the pressures were under better control and higher pressures could be used with safety; the afterblast of air which almost invariably followed the grout from an air machine penetrated a longer distance and over much larger areas than the grout from the hand pump, thereby subjecting a larger surface to grouting pressure without injecting a correspondingly additional amount of solid material. A trial of the air machine in an attempt to speed up the work resulted in a slight lifting of the overhead structure.

To do the grouting at this point a crew of ten men worked one shift per day for about two and one-half months, three-fourths of this time being spent on the squeezing process.

The over-arch spaces under Centre St. (the main section in Fig. 2) were treated in a similar manner and took considerable grout. Numerous small drips and trickles were dried up, but no great quantity of water was stopped, as the initial leakage was not large at this point.

Besides the well-defined joint leaks there were a number of drips, small trickles and wet spots on stairways and platforms of the station that were difficult to stop. In these cases a study of the details of waterproofing and concreting usually gave a clue to some channel carrying this water, such as a joint of honeycombed concrete, an empty space under the top flange of a girder, or some similar opening. Often many holes were drilled before finding the water-bearing channel, but the grouting of this channel, once found, would dry a number of small leaks.

Probable Action of the Grout—In the use of grout to stop the leaks in this station, it was not intended to substitute a cement waterproofing for that already in place, but rather to repair the original waterproofing by plugging the breaks whenever they occurred. The grouting did fill shrinkage cracks in the concrete, closed spaces which were formerly water channels, and made the concrete of the walls themselves (1:2:4 mixture) much more waterproof, supplementing the regular waterproofing in this respect. In fact, the work was done in the winter time when the structure was most contracted and shrinkage cracks open the widest, the best time for filling them.

The quantity of cement used in thick grout mixtures indicates the filling of over-concrete spaces of considerable size, all of which helped to make tight the concrete structure inside the waterproofing. But it was at the joint between structures where the main break in the waterproofing occurred, and the thoroughness of the seal at this point was given the most consideration. Squeezing this joint with thin grout at pressures considerably above the groundwater pressure was done again and again, until there was not only an impervious layer of cement in the break, but spaces in earth outside or in adjacent structure inside were thoroughly filled.

It is considered that further movement along the defective joints due to temperature changes will be slight, if any occurs at all, and that the resulting leaks will be negligible, for the following reasons:

The range in temperature is not great—practically that of the groundwater, which betwen February and August, 1919, ranged from 53 to about 65 deg. F.; the backfill has been placed since 1917 and has thoroughly settled and gripped the structures; the grouting of the shrinkage cracks (which furnish the give-and-take space for contraction and expansion) will tend to stop the movement; joints that have been exposed from January, 1919, to August, 1920, give little evidence of such movement (there is slightly more seepage in the winter than in the summer time) and the unexposed joints which have open pipes leading directly to them show no sign of increased leakage; the original waterproofing both above and below the break is elastic and can slide slightly on the injected cement plug. Since the concrete structure inside the waterproofing has been made practically impervious, even if the joint should open slightly only a seepage could come through.

Permanent drains leading from the hollow tile behind the station finish have been installed along the platforms and stairways to take care of seepage, should it ever occur. The grout pipes will be left open for regrouting until the effects of temperature changes have been fully found out. The leakage at present is less than 1½ gal. per min., distributed throughout the station in sweats and drips, the individual cases being too small for regrouting and so small that they will probably silt up in time.

Special Phases of the Grouting Work—In very fine cracks and for closing some joints a thinner mixture than regularly used was applied: ¼ bag of cement to 24 gal. of water. For some of the very thin mixtures, clay to replace the cement was tried, in hopes that it might penetrate such small seams better, but without material success.

Standard brands of cement were used, of standard fineness (78 per cent passing No. 200 sieve). A considerable quantity of the coarser particles was eliminated by keeping the pump suction about 6 in. above the bottom of the tub. The coarser material settled to the bottom and was removed as soon as any quantity accumulated. In the squeezing of some of the finer cracks, 10 to 15 per cent of the cement was thus discarded

Neat cement grout was used throughout, as it would work into smaller cracks and penetrate much farther under low pressures than cement-and-sand grout. The fact that station roof, walls and floor formed large flat surfaces, and the danger of lifting the overhead structures, limited grouting to comparatively low pressures, 40 to 70 lb. This was particularly a handicap in filling small seams, where the friction used up most of the grouting pressure rather than the groundwater head against which pumping was done.

The total amount of cement used throughout the station to fill open cavities was 6,000 bags, the total amount squeezed into cracks and joints 650 bags. The work was practically finished May 1, 1919, seven months from the time of starting; an average force of 12 men was employed one 8-hr. shift per day. The air compressor was in service three months. During the summer of 1919 grouting was done at different times to dry up a few remaining seepages in the stairways.

One of the most difficult features of the work and one that added much to the expense was the necessity of doing it on the same platforms over which thousands of people passed daily to and from trains. Night shifts helped to some extent, but New York City never sleeps, and besides there was some work that had to be done on day shifts. As much study was put upon methods to attain least interference with and greatest safety to the public as upon planning for the success of the grout injection itself. The officials of the Brooklyn Rapid Transit Company aided much in giving such privileges as they could, consistent with train operation.

The work was done by the Underpinning and Foundation Co., under the direct supervision of the engineers of the Public Service Commission. Many of the data given and many of the statements as to conditions at the leaking joints have been furnished by A. J. Mayell, Assistant Division Engineer of the Public Service Commission. The author had charge of grouting methods in the field, for the Public Service Commission.

Electrification of Railways

With a view to the electrification of the Chemin de Fer du Midi, preliminary work is being done on the harnessing of the waterfalls in the Valley of Ossau. In order to obtain the maximum water power a system of three falls is planned. The cost of the work is estimated at 100,000,000 francs, and the project will be completed within five years.—*Commerce Reports.*

Costs on Commission-Built Roads

By J. H. Philips
Principal Assistant Engineer, Essex County Park Commission, N. J.

THE COSTS given below for two pieces of road constructed by forces of the Essex County Park Commission are exclusive of any overhead costs or the cost of rental of plant used on the work. The plant employed was all the property of the Park Commission and the actual cost of plant repairs was charged against the jobs.

Valley View Drive, South Mountain Reservation, built in 1913 is 5,307 ft. long and contains 12,560 sq.yd. of pavement. It was constructed of a telford base of about 5 in. in depth. The stone for the telford base was obtained from the road excavation and from nearby stone fences in the reservation. On this telford base was spread about 3 in. loose of 1½ in. trap rock. This was thoroughly rolled and was penetrated with 1¼ gal. per sq.yd. of Tarvia X put on with nozzle pressure distributor. On this was placed sufficient ½-in. stone to cover the tarvia, immediately after it was applied. This course was then thoroughly rolled and any excess ½-in. stone swept from the surface. About ¾ gal. per sq.yd. of bermudez road asphalt or pioneer road asphalt was applied by hand. On this was spread clean ⅜-in. trap rock, after which the surface was again rolled. The unit costs of this work are represented by the following figures:

Grading, drainage and fence	$0.3959
Hauling and placing Telford	.2808
Cost of 1½ in. stone	.2431
Spreading 1½-in. stone	.0141
Tarvia 1.32 gals. per sq.yd	.1585
Asphalt 0.795 gals. per sq.yd	.0903
Applying asphalt	.0632
Rolling	.0201
Screenings, both coats	.0528
Supervision	.0198
Total cost per sq.yd	$1.0486

This road has had one surface treatment that being in 1916. The treatment consisted of 0.35 gals. per sq.yd. of bermudez road asphalt applied by hand covered by about 20 lb. of clean ⅜-in. trap rock per sq.yd. at a cost of $0.0819 per sq.yd. It is now in very good condition. The traffic on this road is almost entirely pleasure automobiles.

In the addition to Weequahic Park, we laid 24,375 sq.yd. of bituminous macadam in 1914 and 1915. The road had been previously rough graded by contract and no grading is included in this work except the fine grading of the subgrade.

This road is a 6-in. macadam roadway laid in two layers and given a double penetration of Tarvia X and Standard Oil asphalt, binder B. The tarvia was applied with a nozzle pressure distributor and the binder B asphalt with a Standard Oil pressure distributor. The unit costs were as follows:

Labor, fine grading, spreading stone, etc	$0.1836
Stone, including screenings	.5528
Rolling, including coal, water and repairs	.0411
Tarvia X about 2 gal. per sq.yd	.1966
Asphalt about ¾ gal. per sq.yd	.0330
Drainage	.0021
Total cost per sq.yd	$1.0492

The traffic on this roadway is restricted to pleasure vehicles. This road was given a surface treatment of about ⅓ gal. per sq.yd. of binder B Standard Oil asphalt in 1917, applied with a pressure distributor at a cost of about 6c. per sq.yd.

Removal of Vegetation from Twin Falls Irrigation Canals

Modified Disk Harrow Successful After 8 Years' Trial of Various Methods and Machines—Cost $24 Per Mile

By R. M. Adams
Superintendent of Maintenance, Twin Falls Canal Co., Twin Falls, Idaho

THE two costliest items of expense connected with the work of the maintenance department of any of the irrigation systems in the Snake River valley are the removal of aquatic plants, or "mossing" as the process is called, from the bed of the canals and laterals, and that process called "grubbing willows," which consists of the removal of willows, sweet clover, weeds and vines and the puddling of gopher holes. Usually the willow grubbing must precede the mossing work, and as a rule the

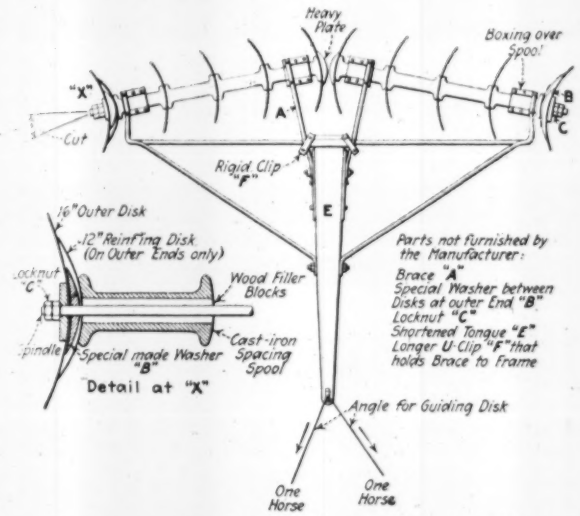


FIG. 1. DISK HARROW STRIPPED FOR MOSSING

two processes must be used on all waterways not over 6 ft. in depth, not flowing over 4 sec.-ft., the water not below 50 deg. Fahr. and not alkaline to any great extent. On the ordinary irrigation system of the locality most of the distributing canals in earth section do not fall under any of the above exceptions, and the mossing must be done regularly at least every year, and often every month during the period of maximum flow in the summer. Willows are usually cut off just under the surface of the ground during the winter or early spring so that the grass and weeds may be mowed along with the tender willow shoots at the time the mossing is begun. On the Twin Falls Canal Co. project the only sure way found of eradiction has been to uproot the moss, and for this purpose the disk harrow has been utilized.

A project having from 2,500 to 3,000 miles of laterals may well devote a considerable amount of money to investigate means for the control of the pest. Some of the larger projects having made long-time studies of moss and of machinery adapted to the work of taking it from the waterways effectively and cheaply. The Twin Falls Canal Company has made no special appropriation for the work but considerable thought and work has been expended on the subject over a period of eight years. A means has been found which is not too expensive, one which seems to be a long step toward eliminating the pest at least from the head-ends of the laterals and canals, and perhaps eventually of the whole length of each lateral. Any such result will be a great boon to operating and maintenance men throughout the intermountain country.

In the *Reclamation Record* for April, 1917, Barry Dibble mentions the methods tried out on the Minidoka Project of the U. S. Reclamation Service as follows:

> During the season of 1916, 260 miles of cleaning were done. The total cost of this work was $4,200, making the cost per mile a fraction over $16. The average cost per mile of the different methods is about as follows: Sawing (with Ziemsen submarine saws), $22; chaining late in the season, $8; cutting with scythes in the laterals, $11; spring tooth harrow in laterals, $9.
>
> Weeds, grass and willows growing along the inner slopes of the canals and laterals decrease the discharge to a considerable extent by retarding the velocity. These are removed by men with brush scythes at a cost of about $12 per mile. . . . In the past little attention has been given to willows on the Minidoka Project, but we now believe that it is advisable to cut them annually. The clearing during the past season was done with the idea of keeping the stumps down so that a mowing machine can be used to cut the new growth. Our cost on the removing of willows has been about $27 per mile.

In the same issue of the *Reclamation Record*, A. J. Hamilton, irrigation manager, Salt River Project, wrote as follows:

> The Acme harrow . . . slices off the top surface of the silt, and after the moss roots are thus cut the moss floats to the top and is then caught by men stationed below on bridges or checks. . . . The Acme is also useful in stirring up the silt in the bottom of the canal, again causing it to be picked up in suspension, with the result that the silt deposits are considerably lessened. The stirring of the silt with the resultant muddy water tends to retard the growth of the moss farther down the canal and it also helps to puddle the leaky places.

It is regrettable that this writer says nothing about the cost of the work done with the Acme orchard cultivator. It is a blade machine that does not stop the growth of the moss, for it acts largely as a harvesting machine. From the experience of the writer with similar apparatus, it requires a continual removal of the accumulations of packed moss from the frame and tongue, which is an expensive operation.

The project which this article concerns is on the same side of the Snake River and a short distance downstream from the Minidoka project, so that the conditions governing the growth of moss are the same. Mr. Dibble's costs are probably what would have resulted on this tract had the same machines been used. This was not done due to a lack of special appropriation for the purpose, and a tendency on the part of the managements of the past not to make large expenditures of money, even at the risk of a great depreciation of the system.

Early in 1918 the first experimental work with a disk harrow was done on one of the main canals, with results which seemed to justify a more extended use of some such machine, but it was evident that many changes were necessary to make the machine successful in general use on the larger canals and also on the laterals. Several machines were assembled in the repair yard, but none was sent out to the gangs until the style shown in Fig. 1 was perfected by using a John Deere orchard disk harrow with a tongue, stripping off all but the essentials, cutting off the tongue to a 7-

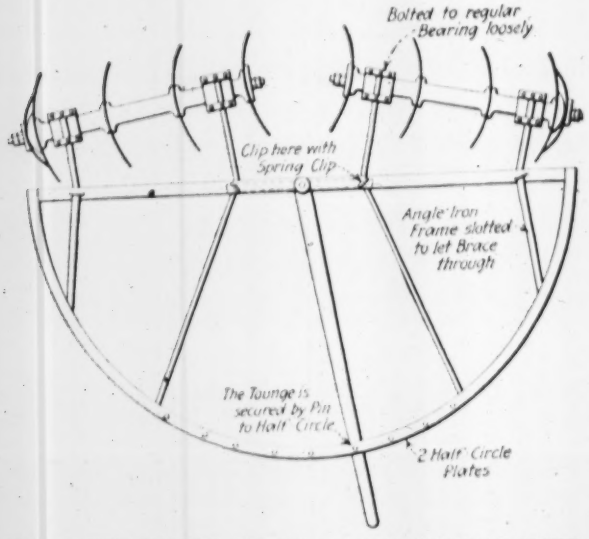

Bolted to regular Bearing loosely
Clip here with Spring Clip
Angle Iron Frame slotted to let Brace through
The Tounge is secured by Pin to Half Circle
2 Half Circle Plates

FIG. 2. TWO-PLATED CIRCLE ALLOWS ANGULAR MOVEMENT OF TONGUE

ft. length, and reinforcing the outside disk on each spindle with a smaller disk-blade. The reinforcing blade is placed on the inside of the outer end blade. A washer between the the outer and reinforcing blades thick enough to fill one-third of the space keeps the strain from breaking the blades should a thoughtless workman tighten the nut to much. The spring, obtained by squeezing the outer disk blade to the smaller one tends to keep the whole apparatus tight. In addition to this feature, the outer nut on the spindle has a lock-nut feature which maintains a uniform tension on the set of disk blades while disking over rough, rocky places in the canals. This locknut is essential, since the right-and-left thread of the respective spindles does not insure that the nuts will not loosen and allow the whole harrow to be wrecked. The boxes, with the wood fillers are retained, also the hard oil cups.

The tongue is supplied with a gage-coulter near the upper end to help get the machine upon the banks, as the horses often cannot assist. The tongue is set rigidly in the center of the machine, with all bracing dependent on it. This arrangement makes it necessary that the clips over the braces to the spindles be more or less rigid, which precludes any but a permanent set in the "cut" of the blades. This feature should have been avoided, because the cut causes considerable breakage on ditches with narrow bottoms and rounded corners. The main requirements are that the disk must sink into the silt of the bottom of the ditch, must not break if rock is encountered, and must not have anything on it which will break off if the whole machine turns upside down. With these points in view the disk is very successful, though it is not heavy enough for anything but mossing in silt deposits, and even for that does not stir the silt into suspension as was hoped.

Another type of frame was adopted in which the undesirable features in the first kind were eliminated. Fig. 2 shows the essential differences. The heavy, reinforced two-plated half circle allows lateral angular adjustment of the tongue, so that the horses may work abreast and can be handled on the smaller ditches by one teamster. The clip holding the spindles is not drawn up rigidly to the frame supporting the side, but a 2 to 4-in. play vertically is permitted, saving a great many disks from breakage. Because the frame is in the form of a half-circle the moss that catches on it slips off the end so that machine needs cleaning usually only twice a day. In the first type, if one horse pulled from each bank one of the cables was necessarily 50 ft. or over in length and ran from the singletree to the end of the tongue. A shorter cable to assist in guiding the harrow led to the other horse on the opposite bank. In consequence the forces applied to the end of the tongue were nearly (sometimes quite) at right angles to each other. It is evident that one driver could not drive both horses, and, unless the depth of the water and the temperature were such that horses could be worked as a team in the bottom of the ditch on a short cable-hitch to the disk, two drivers were supplied. This fact, coupled with the drivers dislike of wading in the cold water, led to the use of the second machine in the colder weather. Also it has been found that the second machine is heavy enough to uproot the mosses, and to turn and stir any material softer than shale. The workmen found that the most effective manner of using the machine was to disk, say, a mile of ditch with the harrow right side up, then to turn it over

FIG. 3. MACHINE 1 AT LEFT. FRAME FOR NO. 2 AT RIGHT

and drag the machine upside down against the current over the disked material. All moss roots are turned out by this method, and much of the silt is moved. However diligent a crew may be, even using horses in the water, volcanic ash silt cannot be moved far by the disking process.

As the project of the Twin Falls Co. is a Carey Act project, the contract calls for a continuous flow of water in the canals during the irrigation season to every water user. When the water is shut off there is difficulty with the former, and it is for the purpose of getting all of the work done without shutting off any lateral that the cleaning devices were made. If the silt deposits can be eliminated while the water is running, the moss has not the best ground to grow in, and is more easily exterminated. Hence the second harrow is the more useful of the two.

A large saving in breakage resulted from reducing the number of blades used on a side from six and eight to four. The speed in handling the machines was so much increased that it was decided to use only eight blades on the machine for all ditches of a bottom width less than 14 ft.

A mossing crew during the season of 1919 consisted of four men, including the foreman, who was paid $4.50 per day, and a cook, who was paid $3.33 a day, two teams—if the horses were being worked in the water—$3 per day each. The outfit for the crew included a wagon camp, mess and bunk, one California wagon and a meat house enclosed with mosquito netting.

The average ditch with moss not over 6 ft. in length was covered at the rate of 1¼ miles per day. In other words, the cost of moss removal, not including the grubbing of willows, or other work, is $20.58 per mile. Adding depreciation on tools and equipment of $4 per day, the total cost per mile is about $24. The costs quoted from the *Reclamation Record* probably do not include depreciation. The feature of supplying the mossing crews with wagon camps is a large factor in efficiency. Men who work all day in wet clothing at a job as disagreeable as is mossing have much better morale when a good cook is in the party.

Pittsburgh Contractor Compares 1919 and 1915 Costs

THE accompanying table, comparing costs of labor and materials during 1919 with those prevailing in 1915, recently appeared in *The Bulletin* of the Associated General Contractors of America. The data were taken from the records of a Pittsburgh contractor.

Materials:	1915	1916	1917	1918	1919	Per Cent Increase 1919 Over 1915
Brick	$7 50	$8 00	$12 00	$17 00	$16 00	113 3
Hollow tile	21 20	26 00	46 00	52 00	59 20	180 0
Foundation tile	10 00	12 00	12 00	16 00	16 00	60
Cement	1 03	1 41	1 66	2 18	2 15	108
Lime	10 00	10 00	11 00	13 70	13 70	37
Sand	70	90	1 20	1 70	1 80	157
Gravel	60	70	1 00	1 50	1 60	165
Steel, structural	36 00	46 00	120 00	120 00	92 00	155 6
Steel, reinforcing	40 00	48 00	75 00	80 00	65 00	62 6
Bill lumber	25 50	28 50	30 50	38 50	40 00	56 6
Mill work, wd. fr., sash and trim	4 75	4 75	5 25	5 75	6 85	44
Outside door fr. and trim complete	9 00	9 00	10 25	11 50	13 50	50
Inside door trim complete	5 00	5 00	6 00	7 00	8 00	60
Roofing	4 25	4 75	5 75	6 75	7 25	70 6
Hardware	335 00	482 00	624 00	663 00	632 00	88 1
Ceramic tile fl.	12 00	16 00	17 40	24 00	24 00	100
Glazed tile wall	22 50	30 00	32 50	42 00	42 00	87
Plaster Paris	12 00	12 75	14 75	20 50	24 00	100
Neat plaster	12 00	12 75	14 75	20 50	24 00	100
Wood lath	5 50	5 50	7 25	8 00	8 00	45 4
C. I. fittings	27	41	49	81	77	185 1
Steel pipe	22	33	43	64	56	154 5
Radiators	16 88	19 25	28 00	42 25	36 12	114
Boilers	26 68	29 60	36 80	60 00	36 80	37 8
Plbg. goods	176 00	215 00	295 00	383 00	326 00	85 2
Electrical conduit	39	38	65	875	915	134 6
Electrical wire	18	26	38	34	28	55 5
Plate glass		12 00	15 00	18 00	18 00	50
Window glass		11 00	14 00	20 00	20 00	81 8
White lead	7 75	8 75	11 75	11 75	11 70	50 9
Varnish	1 50	2 10	2 55	3 15	3 15	110
Linseed oil	53	67	98	1 42	1 44	171 7
Elevators	3,720 00	4,090 00	4,500 00	7,000 00	5,000 00	34 4
Sand stone	65	66	75	75	95	46 1
Lime stone	71	77	82	1 07	1 07	50 7
Labor:						
Common labor	2 00	2 34	3 60	4 25	4 62	131
Bricklayers	5 80	6 00	6 00	6 60	7 20	24 1
Hod carriers		3 00	3 00	4 40	4 40	46 6
Carpenters	4 50	5 00	5 50	6 40	6 40	42 2
Roofers	4 40	4 80	5 60	6 40	6 40	45 5
Plumbers	5 50	5 50	6 00	7 50	7 50	36 3
Plumbers helpers	2 50	3 00	3 50	5 00	5 00	100
Steam fitters	5 00	5 50	6 00	6 43	7 20	44
Steam fitters helpers	3 00	3 00	3 50	4 00	4 80	60
Electricians	5 00	5 00	6 00	7 20	7 20	44
Tile setters	5 00	5 20	5 20	6 00	6 00	20
Tile setters helper	2 80	2 90	3 00	4 00	4 00	42 9
Steel workers	5 18	5 60	5 60	6 53	7 00	30 1
Hoisting engineers	5 00	5 00	5 60	6 40	6 40	28
Elevator workmen	5 50	5 50	5 80	6 30	6 60	20
Painters	4 60	4 65	5 10	5 60	6 00	30 4
Stone cutters	4 50	4 80	5 28	6 00	6 00	33 3
Stone masons	5 00	5 20	5 20	6 00	6 00	20
Stone helpers	2 00	2 40	2 60	2 60	3 00	50
Plasterers	5 62	5 85	6 00	6 40	6 80	20 9
Hod carriers	3 20	3 40	3 80	4 60	5 20	62 5
Plaster laborers	2 00	2 20	2 60	3 20	3 60	80
Lathers	5 00	5 25	5 50	6 00	6 50	30

Stone Exportation in 1919

According to a recent bulletin issued by the U. S. Geological Survey, 1919 was the banner year for the exportation of stone from the United States. The value of the stone exported was $2,779,389.

Notes from Foreign Fields

FROM LONDON TO GLASGOW

BY E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

THE Whitsun holidays give a three-day break in England's springtime. Officially, only the Monday after Whitsunday is a holiday. As a matter of fact, the offices are deserted on Saturday, while this year the Government offices in London closed at noon on Friday. Being forewarned, I improved the occasion by going to Scotland by easy stages, visiting on the way some of the great cathedrals. It is a trip that can be heartily recommended. An engineer or a contractor is especially well fitted to enjoy these structures. He appreciates the problems involved—he is in a position to appraise the ability of the master workmen of the twelfth, thirteenth and fourteenth centuries.

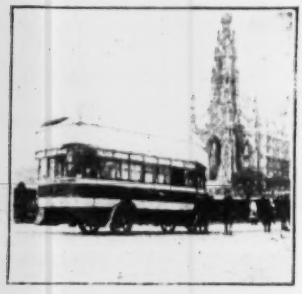
Going from London to Edingburgh, Peterborough, Lincoln, York and Durham are convenient stopping places. Of the cathedrals at these points, Peterborough and Durham are Norman; York and Lincoln, Gothic, affording an opportunity to contrast the styles and to see how rapid was the advance in a century and a half from the heavy Norman, of Durham, to the lightness of the Gothic, at York and Lincoln. I shall not attempt a description of these cathedrals; *Engineering News-Record* is not the place for such details. I advert to the subject only as encouragement to engineers and contractors who visit England to visit some of the cathedrals and to live for a brief space in the ages that wrought these miracles in stone. After seeing them, no one will ever again class the Middle Ages as "dark ages." There was a dark period after the fall of the Roman Empire, but the darkness gave way to light in England and France, at least, by the eleventh century. Surely the dawn was past when Durham was built (in the eleventh century) and the day was at the full when the artisans of York, two centuries later, capped their work with the inevitable cross.

Of the five great churches I have seen (Westminster Abbey being the fifth), the greatest by far, in my lay opinion, is York Minister. I expect never to see a more impressive sight, architecturally, than the view through the crossing from the south into the north transept. The arches sweep upward with an overpowering mastery to a height of 100 ft. from the floor, a flood of light tinged a greenish amber pours in through the lantern tower, while in the north wall of the north transept are the Five Sisters, five great lancet windows filled with wonderful seagreen thirteenth-century glass. Like St. Peter's, as Byron puts it, "its grandeur overwhelms thee not." But it is completely satisfying. One is content to stand there drinking in the scene, the huge upward sweep of the graceful columns, the perspective of the aisle arches and the coloring from the great lancet windows. Men and women in the crossing, their shoulders not reaching even the tops of the bases of the mighty columns, look like pigmies in a structure of the giants.

Other sights there are in York Minster that repay the lingering visitor, but if the view through the crossing were the only one it would repay a trip across the Atlantic.

At Edinburgh

The evening of the third day found me at Edingburgh, early enough to stroll down Princes Street, to enjoy the view across the valley park called Princes Street Gardens, and admire the Castle on the hilltop, scene of many a heroic action in the warlike days of Scotland, and stronghold of Scotch power when the nation south of the Tweed was so often an active enemy. English towns are cities of brick; Edinburgh and Glasgow are cities of stone. There are no brick buildings. Everywhere is stone—in the business buildings in town, in the tenements, along the Canongate, in the apartment houses of the middle classes, in the homes of the wealthy, and even in the one-story, two-room cottages of the Scotch peasants which, on their beautiful Midlothian farms, touch elbows with suburban towns. Edinburgh has an indescribable charm. Possibly it is due to the contrast with the English cities with which the eye had been filled for a month. There the narrow streets and lanes, here the wide avenues; there the humbler looking homes of brick, here the stateliness of stone. Here also a snap in the atmosphere that keeps one hurrying along even when the sun is bright—reminiscent of that San Francisco step-lively period between 5 and 8 in the evening.



BUSES IN EDINBURGH RUN BY GAS

This is a war measure caused by shortage of gasoline. Gas carried by bag on top of bus. One charge is good for 22 miles.

Glasgow, also a city of stone, is distinctly more of a commercial and industrial city than Edinburgh. That is apparent when one sets foot in the business district. It has not the air of ease and elegance that one finds in Edinburgh; nor has it the advantages of close-by green hills with which Edinburgh is favored. Arthur's Seat and the Crags are a joy perpetual at the latter city.

The Clyde Disappointing

But if the Glasgow people have lacked location they have done marvelously well in improving on natural advantages for their commercial development. What a disappointing stream the Clyde is! Hearing for a lifetime of the great shipbuilding industry, one cannot help visioning a majestic waterway, something possibly in the class of the Hudson or the Delaware. One finds, instead, a narrow stream that with us would hardly get into the "river" class. In fact, so narrow is it that the shipbuilding ways are set at an angle of somewhat less than 45 deg. with the bank, and lines are put on the vessels in launching to prevent them being damaged by the opposite shore. Even then one wonders how a 500-ft. ship can be safely launched. Yet here, for miles, are solid lines of shipyards. The great ships, the *Lusitania* and the *Aquitania*, 900-footers, were built and launched at the yard of John Brown & Co., Ltd., at Clydebank, a suburb, but at this point a tributary comes into the Clyde and the ways are so placed that the ships run up the tributary in launching. At other points bends in the stream are utilized for the location of ways for the larger vessels.

ON THE FORTH BRIDGE

No engineer should go from Edinburgh to Glasgow without stopping at the Forth Bridge. View shows main members of support of floor system. Original track troughs are now in process of replacement.

Like all parts of England, Scotland industrially is very busy. Like England, too, conditions are disturbed by constant labor difficulties. Here, though, there is a noticeable hardening that is only talked of in England; that is, the shipbuilders and manufacturers feel that if further labor demands are pressed, without an increase in production, the industries will have to close. Orders are less plentiful than they were. In England this sort of thing is being experienced, but apparently Scotland is farther along in the process, and consequently the attitude of the employers is more matured. What happens here, of course, is likely to react on English conditions.

Glasgow, May 1.

STONE BLOCK PAVING IN GLASGOW

GLASGOW, I had been told, was one of the best paved cities in Europe. I am not in a position to approve or disapprove so sweeping a judgment, but certainly the pavements are remarkably good. The city engineer and master of works, Mr. Thomas Nesbit, is apologetic for them. The war prevented the high degree of maintenance on which Glasgow prided itself. The very best testimony to the excellence of his work, though, is the very good condition of the pavements after five years of relative neglect.

By far the greater mileage is in stone block. Obviously the excellent local supplies have been a factor in promoting this extensive use of stone. Traffic, though, has had an important bearing. Glasgow is a great industrial center and the pavements are subjected to exceptionally severe service. Thirty to forty-ton loads on four wheels are usual, while loads up to 100 tons are not uncommon. In one recorded case the gross load on four wheels was 140 tons and the bogie was drawn by five traction engines. It is hardly necessary to remark that these excessive loads (100 and 140 tons) leave behind them trails of destruction. Action is now being taken by the Corporation of Glasgow to test the liability of the street-user for the damage caused. There is no law that allows the Corporation to restrict the maximum loads.

The horse-drawn traffic of Glasgow is still in greater proportion to the total than is the case in London or in our American cities. Extensive use was made for a time of creosoted block, using many varieties of wood, but the results were unsatisfactory. Because of the heavy loads made possible by the excellent stone-block pavements and the frequency of wet days, the horses in Glasgow are sharp-shod. Their calks cut the wood

blocks badly, while the constant moisture kept the blocks wet and slippery. Glasgow has many steep gradients, so that slippery pavements are naturally unpopular.

These conditions have resulted in the very extensive use of stone block. The block used are generally 4 in. wide, 7 in. deep and about 9 in. long, set in a sand bed on a 6-in. concrete base. Their adherence despite their heavy traffic to a 6-in. base may cause surprise. I had heard in the States that good paving practice in Great Britain was tending in the direction of thicker bases. That is true in London, but the practice at Glasgow has been fully justified by results. Glasgow, however, is favored with excellent subsoil conditions—gravel and boulder clay. Moreover, a rich concrete is used, 1:1½:4, while the aggregate is a whin, resembling our trap, graded up to 1½-in. maximum.

WHEEL TRACKS ON UP-GRADE, A COMMON PRACTICE IN GLASGOW

A fairly close dressing of the blocks is required and in general the joints are about ⅜-in. wide. The joints are cement-grouted when it is possible to close the street for a sufficient length of time, but as a rule pitch jointing is used. Their jointing practice presents an unusual feature. The joints are first poured with a course of pitch and ⅜-in. granite chips are then swept in followed by another pouring of pitch, another layer of chips and a final filling with pitch to the tops of the blocks. This practice originated in an effort to prevent granite-block on grades from canting under traffic. It not only prevents canting but insures a longer life by keying the blocks more securely.

In the selection of stone for blocks great care is taken—another example of the thoroughness that impresses a visitor on this side of the water. Long experience has indicated the stone that will wear uniformly. The hardness and toughness are such that the edges do not wear or chip faster than the surface. Two of these stones, to the eye at least, are in decided contrast. One is of exceptionally fine grain; the other is coarse. Both, though, have been found to give excellent results. Geologically the stones are andesites, though they fall under what we, in paving practice, generally term granite.

One of their favorite quarries is in a large group, but this is the only quarry in the district from which Glasgow will accept block. Moreover, in that quarry there are two kinds of stone, only one of which is approved. Stone, to Glasgow's paving engineers, is not merely stone.

In addition to stone-block pavements of the usual type, they have a stone-block pavement which is probably unique—of tool-dressed blocks 6 in. wide, 6 in. deep and from 9 to 15 in. long. The story of its development is interesting:

About 18 years ago there came a request for quiet pavements in the office and shop district. For such streets asphalt was adopted and has given satisfaction except on streets with street-railway tracks. Here there were the usual failures alongside the rails. The first remedial step was to pave between the rails and for 12 in. beyond them with stone block. This practice proving unsatisfactory, the 12-in. strip was paved with block 12 in. wide and from 2 ft. 6 in. to 5 ft. long. With both the small and the long blocks the line of distress was merely shifted to the edge of the stone paving. The decision was then reached to use a large tool-dressed block of the dimensions given above—6 in. wide, 6 in. deep and from 9 to 15 in. long. The results are considered very satisfactory. There is more noise, it is true, than with an asphalt pavement, but less than on the small-block street. The surfaces are remarkably smooth, the large blocks holding true much better than the smaller ones. The initial dressing leaves variations on the surface and sides of not more than ⅛ in. The joints, therefore, are exceptionally close, while the stone is so well selected that even after long service there is no rounding at the corners.

Naturally the cost is high, varying before the war from 25 to 30 shillings per square yard, these figures including the foundation. In contrast, the pre-war cost of ordinary blocks, 7 in. deep, was from 10 to 12 shillings, and for rock asphalt (2½ in. thick, consolidated) 16 to 18 shillings. Now all paving work in Glasgow costs about three times the pre-war figure.

Against these costs must be set the life. Some of the large block pavements have been down 16 years and are good for another 16 years. Thirty years is a good average for ordinary stone block under the downtown business traffic, while the rock asphalt surface must be renewed after 10 years.

There is so much wet weather in Glasgow that a regular practice is made on wet days of scattering ¼-in. whin or granite chips on the rock asphalt pavements. This "sanding," as it is called, costs about $10,000 a year for labor and materials.

Glasgow, May 28, 1920.

Zoning Progress at the National Capital

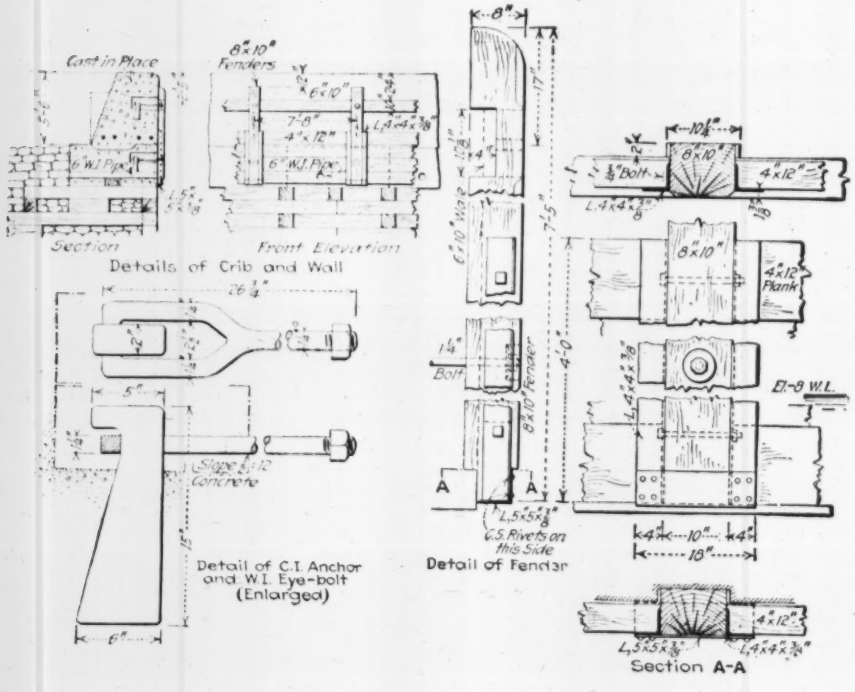
FOUR use districts are provided in the tentative zoning regulations for Washington, D. C., drawn up by the Zoning Commission. These districts, according to a circular issued by Major R. G. Powell, Corps of Engineers, U. S. A., executive officer, are: (1) Residential districts; (2) first commercial districts in which all classes of buildings permitted in the residential districts may be erected, except for 15 specified kinds; (3) second commercial districts, same restrictions as for residence and first commercial districts with 44 specified exceptions; (4) industrial districts, wholly unrestricted except for existing law or municipal regulations. A map has been issued to show the limits of the four districts named above. In a statement accompanying the tentative use regulations it is noted that: "In general, the main thoroughfares have been designated as first commercial. These now have street car lines, or will have them at a future date." Of the industrial districts, the statement says that these are "located along the railroads and on the water front" and adds that: "Each district has been restricted in area so as to prevent a too great concentration of smoke, gas, odor or noise in any one locality. Wherever practicable, small residential areas have been left for workers' homes in the vicinity of the second commercial and the industrial districts."

Timber Fender for Concrete Pier Made Removable

Wood Frame Units Hung From Hooks Cast in Recesses in Concrete—Main Protection Boards Slide into Grooves

ON ACCOUNT of the severe ice conditions and the shutdown of navigation in winter, it is desirable in Buffalo harbor to be able to remove readily the timber fenders to the concrete quay walls. A design permitting this adopted for the fenders on the Bird Island Pier Improvement is shown in the accompanying drawings.

The quay wall here is of the type common to the Great Lakes, that is a concrete section surmounting a rock-filled timber crib. The lower part of the wall proper is of precast concrete blocks and the upper of concrete poured in place. The fender system consists of vertical 8 x 10-in. timbers, with an upper 6 x 10-in. continuous wale and a rubbing face of 4 x 12-in. boards.



REMOVABLE TIMBER FENDERS FOR BIRD ISLAND PIER WALL, BUFFALO, N. Y.

Recesses are cast in the blocks and left in the upper section of the wall at every fender, and at these recesses an iron hook is embedded protruding up into the opening. Every fender has two looped bolts passing through it which hook over the embedded iron, the fender being cushioned from the concrete face by the interposed horizontal wale. Alongside of each fender are fastened structural angles, forming grooves which act as guides for the rubbing timbers.

The fender can be taken down by lifting it in sections from off the hooks and similarly returning when its protection is again required. Rubbing boards can be replaced by slipping the damaged unit out of the guides and dropping a new one in, without any carpenter work or repair to any other part of the structure. The pier with the fender system, was built under the direction of George H. Norton, City Engineer.

Sea Water For Oil Refinery Condensers Secured By Gravity

Thirty-Inch Cast-Iron Pipe Extending 850 Ft. to Sea Lowered From Trestle as One Length—Water Jets Used To Dig Trench

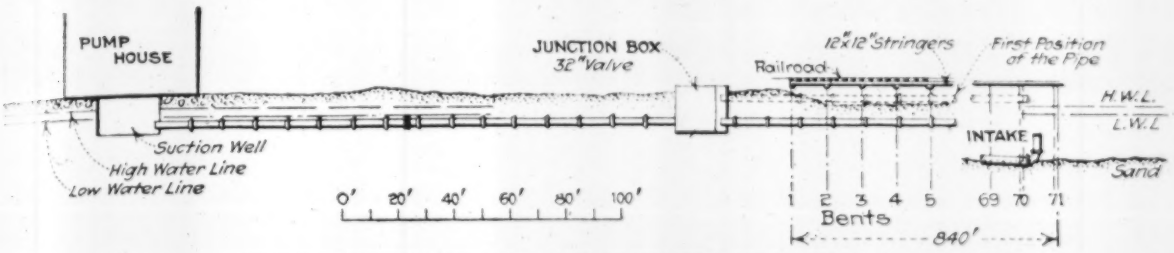
By Leon H. Watts
General Superintendent, Mexican Refinery, Guayabalillo, Ver., Mexico

LA ATLANTICA Cia. Mexicana Productora y Refinadora de Petroleo, S. A., a subsidiary of the Atlantic Lobos Oil Company, is building a topping plant for reducing Mexican crude oil at Guayabalillo, on the Gulf of Mexico, 60 mi. south of Tampico. The property is a strip with 1 mi. frontage on the sea and extending 2 mi. back to the Tamiahua lagoon—a salt water inland lake. The soil is a fine beach sand throughout, of an average elevation of 3 ft. above mean tide. To secure a continuous supply of water to be used in the condensers of the refinery and main pump station, as well as an adequate supply for fire protection, was one of the main engineering problems.

Several plans presented themselves as being feasible—ditching to the lake, pumping from the lake or pumping from the ocean, but each of them chanced possible drying up during the hot season, or depended on mechanical units, which might fail at any time, thus putting the whole plant out of commission. It was finally decided to lay a 30-in. cast iron pipe 850 ft. to sea, to secure a gravity flow to the four centrifugals and two large fire pumps located in the main pumping station.

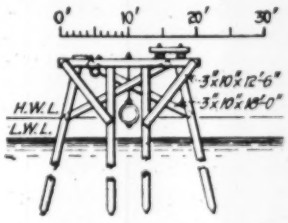
The general plan was to drive a wharf 850 ft. out into the gulf, hang the pipe below it just clear of high water on long threaded rods and then lower it to the bottom and jet it in. There was a bent for each joint of pipe, or every 12 ft. A concrete intake was sunk in the pump house. From this point the 30-in. line was laid in a trench, sheeted, to a clean-out box 14 ft. deep, a distance of 188 ft. On the sea side an opening 32 in. was left from the top to the seat of the sea-end of the 30-in. pipe. Into this box the 30-in. cast-iron valve was placed.

LOWERING THE PIPE



SKETCH SHOWING ORIGINAL AND ULTIMATE POSITIONS OF PIPE

For handling the material on to the wharf a stiff-leg derrick was set up at the shore end of the wharf. Each joint, weighing, 3,500 lb. was placed on a small car and run out to where required, there to be picked up by a small hand winch and lowered into place. The lead for each joint, weighing 100 lb., was also handled by this winch. Three-quarter-inch cable was stretched below every ten joints and tightened up with a turnbuckle. On the shore end for the first 16 bents a fixed jet was attached, which had two sprays each way under each length of pipe. Farther out these jets were placed every 40 ft. In addition, provision was made for hand jets. In all there were 71 bents and 70 rods to handle.



TRESTLE DETAIL SHOWS SUSPENSION RODS EVERY BENT

A gang of 200 men, with a foreman in charge of each 10 bents, started to lower the line at 6 o'clock the morning of Feb. 11. The assistant superintendent directed the lowering from the shore from a position where he could view the whole line and control the relative speed of the lowering of each section. Difficulty was experienced when a few of the nuts became jammed, or cross threaded, which, of course, meant that the bolts on each side had to be held up. A messenger service was established between the shore control and each foreman and "lower" or "hold" was given by bent numbers.

Whole Length Submerged First Day

By noon the whole line was practically at water level. Jetting work was being pushed on the shore end, as there, in order to set the pipe in place, it had to be lowered in the sand 7 ft. As the pipe entered the water, inch by inch, the entire length of 850 ft. was found to be floating, so the valve in the clean-out box was opened, the line filled, and lowered until the pipe just touched the bottom. At 6 p.m. the whole line was under water. The jetting at the shore end was done in shifts, one foreman and ten men working every shift. Tank plates were jetted in at each side of the pipe, and distant 2 ft. from it, from the clean-out box to the sea, which kept the sand from washing in from the sides. It also made a channel down which the sand was washed. A pulsometer was also used in this trench at the shore end. Three joints were worked on at one time. The jets had a washing and loosening action and jacks were used to put the pipe down the last few inches.

From bent No. 20 to 70 it was proposed to use jets but as all this pipe was under from 4 to 11 ft. of water, it was impossible to get results, so that very little work was done.

It was known, however, that there is a strong current down the coast, especially after a storm and this fact was taken advantage of in putting the pipe to its present favorable position. A careful profile was taken of the pipe and bottom. This was studied and where possible the pipe was let down inch by inch until it rested on the bottom and the bolt held no weight. This was accomplished except between bents 43 and 49. On all but these bents the nuts were set up 2 in. From Feb. 27 to March 2 two severe "northers" came up and by keeping a few men on the wharf night and day the wash of the sand from under the pipe was noted, and as the pipe sank the 2 in., the nut would be raised again. A new profile of the top of the pipe, as well as of the ocean bottom, was taken every day, and with this drawn in, gave us data as to where the pipe was high and where low, where hanging and where buried. The rise and fall of the tide seemed to affect the wash as the lowering took place intermittently. But as soon as the nut was tight men were there to set it up another 2 in., provided the sounding justified it.

The pipe is now practically buried for its whole length, but during every successive storm, it must be carefully watched and lowered or held, as seems most expedient. The bottom shifts continuously and during a severe storm it may wash out from under the pipe for a distance of 10 bents. To prevent a possible settling to the breaking point, the cable is stretched below and the rods come into direct action. The wave action against the side of the pipe will not be the real test, I feel sure, but the end of the pipe, with its heavy elbow and nipple subjected to strong wave action, will be the point of greatest danger.

EXCAVATING TRENCH WITH WATER JETS

C. B. Buerger, Chief Engineer of La Atlantica Cia. Mexicana Productora y Refinadora de Petroleo, S. A., was responsible for the plans and specifications.

LETTERS TO THE EDITOR

Narrow Piers May Be Economical

Sir—I note in your issue of July 22, a number of articles attacking the design of the State Island piers in particular and the narrow pier in general.

Though the narrow pier has many disadvantages, limitation of water front may render it necessary, in which case much can de done to increase its accommodation by going upward. The ultimate capacity of a harbor with two story approaches to narrow piers and pier sheds of three or more stories will be greater than that of a harbor with wide piers, the water front being equal in both cases.

There are certain difficulties with regard to handling and checking freight through a many storied pier, difficulties not entirely of an engineering nature but which must be recognized and met by any engineer who hopes to produce a many storied pier capable of successful operation. These conditions may make it worth while to construct narrow piers with a single-story approach and shed provided that in the plans provisions are made for the addition later of a second elevated approach and several stories of sheds.

New York City. J. R. WADE.

Shrinkage of Earthwork

Sir—In connection with the article on shrinkage of earthwork, in *Engineering News-Record* of June 24, p. 1256, my experience covers nearly forty years, but not a very wide stretch of country and not with extremely heavy work: I have always found an average of somewhere near 115 yd. of cut going to make 100 yd. of fill and in at least two cases I have seen 140 yd. required to make 100 yd. of fill, this being surface soil and mainly from casting work. It is my experience that the slopes of embankments are not apt to overrun the stakes, but rather the opposite. In sewer work I have seen a trench made say 8 ft. deep, 10 or 12-in. pipe laid and then all the excavated material put back. This is of course not a fair comparison as the treatment would be very different in the case of the sewer.

Rockland, Me. O. H. TRIPP.

No Bearing on Municipal Ownership

Sir—Your attention is invited to enclosed dispatch that appeared recently in the New York *Times* in hopes that you may see your way clear to find out wherein the rise in water rates "hits municipal ownership", what reasons there are, if any, why water rates should not be increased with the present tremendous increase of the cost of water plant and to give some publicity to your reply perhaps through the editor of the *Times* as well as through your own columns.

Newark, N. J. ARTHUR H. PRATT,
Acting Chief Engineer, North Jersey District Water Supply Commission.

The dispatch, which was sent from Chicago, reads:

> Municipal ownership of public utilities received a setback when announcement was made that the price of water in Chicago is to be increased.
>
> Thousands of property owners will be hit. Not only are they to be called upon to pay more for the daily supply of water, but the regulation discount rate is to be reduced from 25 to 10 per cent. This item alone will mean an estimated revenue of $1,000,000 annually to the municipality.
>
> Alderman Clayton F. Smith, member of the Finance Committee and former City Treasurer, has conducted extensive investigations, and his conclusions not only made clear the immediate necessity of raising the price of water, but swept away one of the biggest and most telling arguments of municipal ownership advocates.

[As a matter of fact, municipally owned utilities have been slower to increase rates than have privately owned, but this proves nothing as to the relative merits of municipal and private ownership any more than does the mere fact that Chicago is raising its water rates.—EDITOR.]

Why Water-Power Reports by Engineers Are Generally Favorable

Sir—In the report of a lecture by J. E. Aldred to Johns Hopkins University students, in your issue of July 1, p. 15, appears the following statement by Mr. Aldred: "Personally, I have seen hundreds of reports on water power projects, but I have never yet seen an unfavorable report."

This statement implies, and the context suggests, an aspersion on the ethics of the hydraulic engineering profession which it seems to me is not warranted by the facts. Generally speaking, it is the projects which possess at least some apparent merit on which engineering reports are made; at least it is as a rule only reports on reasonably meritorious projects which get very far in the hands of competent financial institutions, investment engineers, and development companies. It does not follow that because only favorable reports are generally circulated that others are not made.

The writer has himself made unfavorable reports on water power projects, and knows of other engineers who have done the same thing. What not infrequently happens is as follows:

A client asks to have a certain project investigated and reported upon. In the course of the work it develops that the project has insufficient merit, and either the investigation is stopped, or if the report is completed the client pays for it, charges the cost to profit and loss, and forgets about it.

In not a few instances it has happened that water-power projects have been called to the attention of engineers but no reports have been made, for the reason that the engineer foresaw the lack of merit and so advised the client in advance.

It does not seem at all fair to the engineering profession that so obvious a state of affairs should be construed with a meaning so opposite to the truth.

ROBERT E. HORTON,
Voorheesville, N. Y. Consulting Engineer.

Why Not Open-Top Box Cars?

Sir—In connection with the series of articles relating to the design of the new piers at Stapleton in New York Harbor, which appears in your issue of July 22, 1920, it seems to be timely to draw attention to the archaic design of the box freight cars now in use by our railways.

Loading and unloading of freight cars of the type mentioned is now done through doors in the sides of the cars, and principally by manual labor. Why do we not, in addition to the side doors, build our box cars with doors in the roof?

While there may have been reasons which made it inadvisable to adopt this construction with the old type of wooden freight car, yet with the steel car now developing, it would seem that from a structural point of view, a design could be made which would be amply sufficient, and provide both side and roof openings.

Such a construction would permit the greatly increased utilization of mechanical means for loading and unloading in both land and water terminals, and in large industrial plants, thereby eliminating much unsatisfactory manual labor of high cost, poor efficiency, and much too prone to "take a holiday" whenever the notion strikes them with or without reason.

Would not the use of top doors and mechanical loading and unloading apparatus conduce to elimination of delay in railway equipment now so necessary to the economic life of the country?

The problem of design for cars with both side and top doors, as well as that of securing the contents against damage by leakage through the top doors, is not difficult of solution, and while I have not studied exhaustively the economics of the problem as affected by a possible slight increase of cost per car, plus the installation and operation of mechanical loading apparatus at terminals, yet the greater expedition of operation, avoiding delay in rolling equipment

ease of piling for storage and sorting, loading or unloading between car and vessel, and the elimination of, or large reduction in, an uncertain labor element would seem to put the balance of economy well into the credit column.

KENNERLEY BRYAN,
Consulting Engineer.

New York City.

Results from Alvord Separate-Digestion Sewage Tank at Swedeland, Pa.

Sir—During the last few months there has been some discussion as to the results obtained from the so-called Alvord tank in treating sewage. One meeting of the American Society of Civil Engineers brought out quite a little discussion on this subject. It seems to me that the following data, furnished by W. Collins, of the Alan Wood Iron & Steel Co., concerning the operation results of a plant using an Alvord tank, would be of interest to your readers.

The disposal plant was put in operation in August, 1919, at Swedeland, Pa., to take the domestic sewage from a housing development which the company named had recently built to care for some 350 to 400 persons. A domestic sewer was connected with 79 houses, and the settling tank, siphon, sprinkling bed, etc., were designed to treat from 50,000 to 70,000 gal. daily.

The Alvord tank consists of a settling tank on either side of a digestion bay, the sewage passing through the first settling tank underneath baffles and across the digestion bay into the second settling tank. The principle of operation is that the settled sewage and floating mat should from time to time be withdrawn mechanically by means of valves at the bottom and gates at the top into the digestion bay from which the digested sludge, after standing for a period period, should be withdrawn to the sludge drying bed.

The Swedeland plant has now been in operation for over a year, and Mr. Collins, on May 4, 1920, wrote as follows regarding it:

"The operation from the start has been almost mechanical, we, of course, flushing the screen chamber weekly with a hose, first removing any foreign matter which may have been washed down, such as orange peels or any substance not usually found in sewage. We also remove or siphon the sludge from the first and second tanks after about five months into the digestion chamber where a bag of hydrated lime is thrown in to correct acidity.

"In accordance with state requirements, tests of the sewage and effluent are made twice a week and are reported weekly, with other operating data, to the State Department of Health. The following is one such report taken at random from our files:

GENERAL OPERATING DATA

Day	Siphon Doses	Total Sewage, Gal.	Number Filter Nozzles	Chlorine Gas per Day, Lb.
Sunday	81	67,635	33	1¼
Monday	82	68,470	33	1¼
Tuesday	81	67,635	33	1¼
Wednesday	80	66,800	33	1¼
Thursday	77	64,295	33	1¼
Friday	79	65,965	33	1¼
Saturday	83	69,305	33	1¼

RESULTS OF PUTRESCIBILITY EXAMINATION

	Raw Sewage	Alvord Tank Effluent	Filter Effluent	Re-Settling Tank Effluent
Retains Color	25 hr	96 hr.	+	+
	48 hr.	30 hr	+	+

"All tests from the re-settling tank have been retaining their blue color for a period of two weeks, after which time they are thrown out.

"At the end of eight month the sludge was drawn off and we found that it fulfilled our expectations, it being apparently thoroughly digested, black in color and with scarcely any odor. We believe, however, that it would be a good thing to have all the sludge siphoned out of the digestion chamber instead of three-fourths of it, as is the case in our design."

The Swedeland disposal plant contains all the features as set forth by Mr. Alvord as typical for the U. S. Housing Corporation. The initial cost is less than that of the Imhoff tank; it requires very little attention and that only at long intervals; the sludge produced seems equal to Imhoff sludge, and there is no odor about the plant. Of course it may not be fair to compare these working conditions with those of a military camp, but it seems to the writer that the Alvord tank is very well suited to small communities and institutions producing from 50,000 to 500,000 gal. daily.

New York City. GEORGE L. ROBINSON.

Idaho Corrects Federal-Aid Figures

Sir—On p. 1169 of *Engineering News-Record*, June 10, I notice an article headed "Facts on Federal-Aid Road Work." If the data Mr. Eldridge gives concerning other states is no more reliable than that given for Idaho, I think that the word "facts" in the heading is out of place.

The State of Idaho has not applied Federal-aid funds on any roads except those included in the designated state system. Also, the bulk of Federal-aid so applied has been on the main east and west, and north and south highways. It is the policy of this department to complete two main north and south highways, one in the eastern and one in the western part of the state; and two main east and west highways, one in the northern and one in the southern part of the state, at the earliest possible time, and the Federal aid has been applied with that end in view.

In the table showing Federal aid used on the less durable types of road, Idaho is credited with using 90.1 per cent on earth roads. This is very wide of the mark. As a matter of fact, the lowest standard in Idaho is two-course gravel, and these roads are built wherever they are sufficient to withstand the traffic. It must be borne in mind that in a state situated as Idaho is, the problem is one which involves distance rather than dense traffic. There are only a few communities in the state where the traffic at present is of sufficient density to make concrete, bituminous or brick surfaced roads necessary. As a matter of fact, it would be impossible to confine expenditures in Idaho and many other western states of large area, small population, low assessed valuation and light traffic, to the high grade pavements mentioned above on account of financial conditions.

A new country which is being rapidly developed must be provided with highway communication, and these highways must be constructed of the best possible type, having regard for the traffic requirements and the financial limitations.

A correct percentage table covering roads upon which Federal aid has been applied in Idaho, is as follows:

	Per cent
Earth	14.5
Gravel	50.9
Macadam	21.9
Bituminous concrete or bituminous surfacing on portland cement concrete	12.7

In addition to the above a considerable mileage has been constructed with state and county funds without Federal cooperation. Percentages in this class of road are as follows:

	Per cent
Earth	19.8
Gravel	72.2
Macadam	5.0
Bituminous concrete	3.0

The earth roads shown in these tables do not represent the finished project. On account of financial conditions this year, it was deemed advisable to complete the grading and drainage structures and to begin applying the surfacing next year. In co-operation with the United States Forest Service, 116 mi. of earth roads have been constructed within the national forests. The primary object of these roads is to provide means of access to the forests in order that fire protection might be afforded and incidentally to provide means of transportation between different points within the forest boundaries.

A considerable mileage of this earth road has already been surfaced, and as funds become available, surfacing is being applied. As stated heretofore, it is not the policy of this department to construct unsurfaced roads.

I trust that you will present the corrected tables shown herein to your readers. I am sending copies of these tables

and the facts to the Senate Committee on Post Roads in order that Mr. Eldridge's testimony may be corrected. I cannot understand why Mr. Eldridge should have presented the tables he is credited with inasmuch as it would have been quite possible for him to have obtained the correct percentages from the Bureau of Public Roads.

WILLIAM J. HALL,
Commissioner, Idaho Department Public Works.
Boise, Idaho.

[A copy of Mr. Eldridge's reply to Mr. Hall is given herewith.—EDITOR.]

Sir—We are in receipt of your letter of June 21 enclosing a copy of your letter to *Engineering News-Record* calling attention to what you consider errors in the "facts" presented by me to the United States Senate Committee on Post Offices and Post Roads.

I am convinced from reading your letter to me and the letter written by you to *Engineering News-Record* that you were referring to one thing while I referred to another. The figures I presented to the committee to which you object referred to percentages of *miles* of Federal-aid roads—project agreement—approved by the Secretary of Agriculture up to Sept. 30, 1919. It appears, however, from your letters that you are referring to the percentage of *funds* expended on these Federal-aid projects.

I am satisfied that my figures are correct, as will be seen from a copy of the original table which was obtained from the official records of the U. S. Bureau of Public Roads, which is appended. Copy of the hearings above referred to are also being sent to you. You will see from these figures that the percentages referred to related to *mileage* and not to *funds*.

It is evident from your letter to the *Engineering News-Record* that your figures are for a later period than Sept. 30, 1919, for at that time no project agreements had been approved for your State for macadam, bituminous concrete, bituminous surfacing or portland cement concrete.

PROJECT AGREEMENTS EXECUTED TO SEPT. 30, 1919
IDAHO

	Earth	Gravel	Total
Fiscal year 1917			
Fiscal year 1918	54.360	5.000	
Fiscal year 1919	35.770	4.000	
Total mileage	90.130	9.000	99.130
Per cent of total mileage	90.9	9.1	100.0
Total cost	$619,491.73	$126,679.00	$746,170.73
Cost per mile	6,873.00	14,075.00	

M. O. ELDRIDGE,
Director of Roads, A. A. A. Good Roads Board.
Washington, D. C.

General Robert's Rules of Order

Sir—I have read with much interest the Biography of Brig.-Gen. Henry Martyn Robert, appearing in *Engineering News-Record* of April 22, p. 798. I am one of the many engineers who did not know that the author of the well-known "Rules of Order" was, and is, an engineer.

I first came in contact with the above volume when I was a student at Iowa State College, Ames, Ia., and am only too sorry that somehow or other my copy of the Rules went astray.

However, after I had been appointed to the faculty of the Grootfontein School of Agriculture in South Africa, I joined one of the societies here, and soon found out that the method of procedure during meetings was altogether wrong, according to Robert.

I pointed this out to some members with the result that at the next election of officers they put me in the chair, and meetings were then conducted according to Robert.

To give an instance of how things were done: Assume that there was a motion before the House, duly seconded. A member would move an amendment, get it seconded, and the amendment would then be put to the vote. If the amendment was carried, the original motion was then supposed to be defeated, without having been put to the House. This has happened when the amendment was in direct opposition to the original motion. Now as far as I remember and I may be wrong, but I do not think so, if an amendment is moved, and it is in direct opposition to the original motion, it is the business of the Chair to refuse the amendment. It will then be the business of the opposition to "vote down" the original motion and move an entirely new motion in accordance with their wishes.

It is now many years ago that I was well versed in Robert's Rules of Order, and perhaps I have forgotten a lot of them, but what I would like to know is this: Are English assemblies controlled by the same rules of order or have they a recognized set of their own? For very possibly meetings in this country would be held according to the English method.

If such is the case, it is very evident that they need to be brought up to the Robert standard.

E. J. VAN MEERBEN,
Engineer, Grootfontein
School of Agriculture.
Middelburg, Cape,
Union of South Africa.

War Department Has Wide Field in Inland Waterway Investigation

Sir—In announcing in *Engineering News-Record*, July 17, p. 141, the formation of the Inland and Coastwise Waterways Service of the War Department, you refer to the duties of this bureau as "a hold-over from the war activities of the Railroad Administration." It seems appropriate to invite your attention to the real intent of the Transportation Act, in pursuance of which this new bureau has been created.

In that Act Congress directed the Secretary of War, with the object of promoting and developing inland waterway transportation, to investigate proper types of boats suitable for the different classes of such waterways; to investigate the subject of water terminals for both waterway traffic and joint rail and water traffic and to advise with communities regarding the location, design and finance of such terminals; to investigate the existing status of water transportation on different inland waterways with a view of determining whether such waterways are being utilized to the extent of their capacity; to compile, publish and distribute such useful statistics and data on inland waterways as might be deemed of value to the commercial interests of the country; and to investigate such other matters as might tend to promote and encourage inland waterway development.

As an incident to the performance of the foregoing, the Secretary of War was directed to take over and either operate or cause to be operated the waterway equipment contracted for by the Railroad Administration.

It is evident from these facts that the functions of the Inland and Coastwise Waterways Service cannot truthfully be termed a "holdover" from the late Railroad Administration. While it is true that that organization was responsible for the design and construction of the fleet of 165 internal waterway boats which are now being operated by the War Department, it is important to note that the interests of the Administration in these boats was primarily for the transportation of freight during the war emergency as a measure of relief from the then existing railroad congestion. The present purpose of the government, on the other hand, is nothing short of constructive promotion and development of our national waterway resources, in connection with certain features of which the former Railroad Administration boats are being utilized.

The Secretary of War has considered this undertaking to be of such importance to commerce generally that he has seen fit to entirely separate this work from the normal military operations of the War Department; hence the establishment of the Inland and Coastwise Waterways Service. The work which this bureau is now undertaking presents such interesting and important possibilities that it seems to me essential that it be differentiated from the purely emergency activities of the Railroad Administration

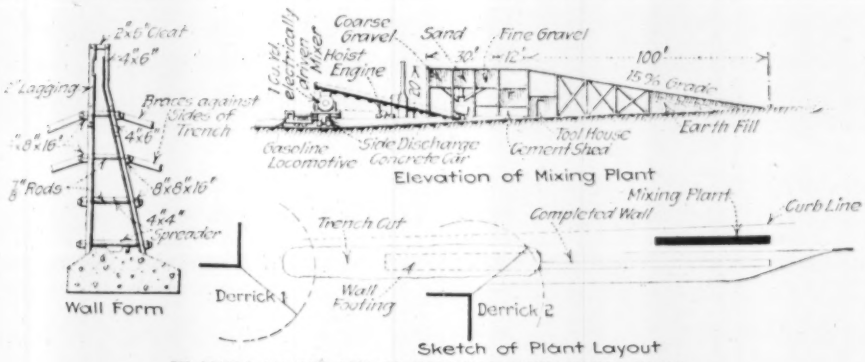
FRANK T. HINES,
Brigadier General, U. S. A.,
Chief of Inland & Coastwise Waterways Service.
Washington, D. C.

HINTS FOR THE CONTRACTOR

Mixing Plant Designed for Long, Narrow Site

A MIXING plant layout adapted to a long narrow site is a feature of one of the long retaining walls which replace levees where buildings restrict the width of the channel improvement works at Dayton, Ohio. The wall is 1,036 ft. long and 25 ft. high and is concreted in two lifts as indicated by the drawing. A very narrow strip of ground at one end of the wall was the only available location for the mixing plant, and indeed the whole operation had to be conducted along an area scarcely 50 ft. wide from the street line to the top edge of the old levee.

As indicated, Derrick 1 excavates the trench with a clamshell and Derrick 2 handles the concrete buckets and the 16-ft. sections of forms. Materials are hauled in 5-ton motor trucks to the mixing plant where they



PLANT LAYOUT AND FORMS FOR RETAINING WALL

are dumped into hoppers at the top of an incline, leading to bins for the sand and aggregates. The sand runs from ¼ in. down, the fine gravel from ¼ to 1½ in.; and the coarse gravel from 1½ in. to 3 in. The bins hold about 15 cu.yd. each.

From the bins the materials are drawn through chutes into a bottom-dump car running on a track built at 15-deg. incline, which leads to a platform over the mixer. Between the chutes and the car, measuring boxes are interposed, which permit the proper proportioning of the material. These proportions are 4 sacks of cement to 9.6 cu.ft. of sand, to 10 cu.ft. each of the fine and the coarse gravel. This gives a 1:2.4:5 concrete.

The car is hauled up the incline by a single drum hoist engine, and dumps at the top into a hopper which holds one complete batch. This hopper is kept filled. From the hopper the batch is drawn into a 1-cu.yd. mixer, driven by a 7½-hp. alternating current motor, and is given a one-minute mix. From the mixer it is discharged into concrete cars running on a 3-ft. gage light railway leading alongside the wall excavation, whence it is discharged into the concrete forms. The cars are drawn by a 3-ton gasoline locomotive.

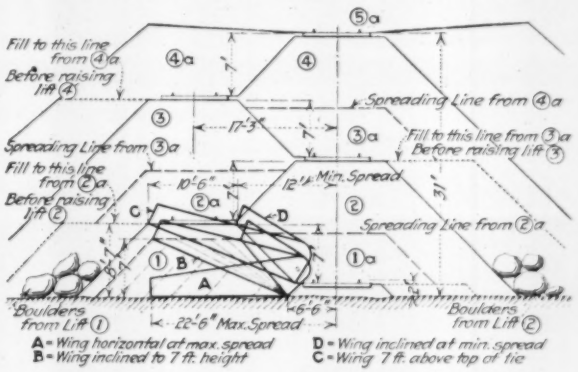
The concrete cars are of two types. One is a side-dump car, discharging its materials into the form for the footing through a sloping chute. Materials for the upper part of the wall cannot be thus chuted, the wall top being on a level above that of the concrete track. In this case a bottom dump bucket of special form is used, riding on a small platform car, from which it is lifted by Derrick 2 and dumped wherever wanted. Both types are of one cubic yard capacity.

The wall is a portion of the channel improvement works at Dayton, Ohio, of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Chas. H. Paul, assistant chief engineer and C. H. Locker, construction manager. The division engineer in charge of the Dayton channel improvements is C. A. Bock.

Build Fill With Spreader Car

A METHOD of building fills by dump cars and spreaders, avoiding the use of trestles, is indicated by recent work of the Oliver Iron Mining Co., Hibbing, Minn., in forming a waste dump of gravel overburden

The spreader car used was described in *Engineering News-Record* of April 29 1920, p. 866. Although the fill thus built was 7 ft. high the accompanying diagram shows the possibility of extending the process for a total height of 30 ft. Side-dump cars of 20 yd. capacity were employed. A 2-ft. fill was built first by dumping and spreading level with the rails, a trainload of waste gravel being then dumped from the track on this new fill. This dump was leveled in successive runs with the spreader car having its wing at an increasingly wide angle to the back. At the same time the heel of the wing was dropped gradually so as to throw material farther away and to cut below the rails to prevent


Fill to this line from ④a Before raising lift ④
Spreading Line from ④a
Spreading Line from ③a
Fill to this line from ③a Before raising lift ③
Fill to this line from ②a Before raising lift ②
17'-3"
10'-6"
12' Min. Spread
31'
Spreading Line from ②a
Boulders from Lift ①
22'-6" Max. Spread
6'-6"
Boulders from Lift ②
A = Wing horizontal at max. spread
B = Wing inclined to 7 ft. height
C = Wing 7 ft. above top of tie
D = Wing inclined at min. spread

HOW TO BUILD A HIGH FILL WITH A SPREADER

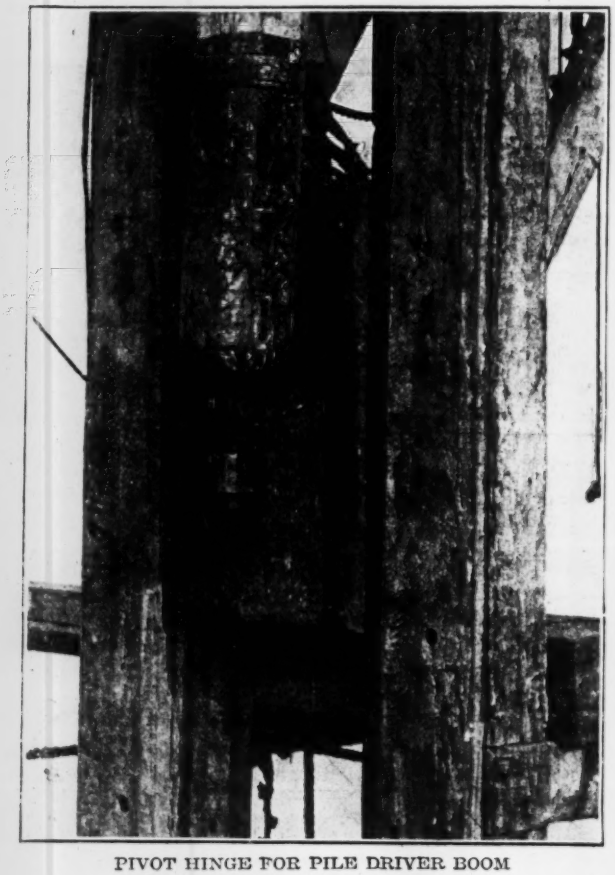
additional dumped material from rolling back near the track. After the inclined wing had built up the fill, the wing was raised and set horizontal so as to level the fill. These operations are repeated in frequent runs until the fill had a height of 7 ft. above the rail

and a top width of 10½ ft. This width would have been sufficient for the next position of the construction track if it had been desired to increase the height and width of fill.

Boom Attachment for Pile Drivers

By C. W. Geiger
San Francisco, Cal.

AN UNUSUALLY wide radius of operation is permitted by the pile driver boom attachment shown by the accompanying view. An eye-bolt set through the hammer receives the hinged pivot pin attached to the foot of the boom and provides for the horizontal and vertical swing of the boom. By raising or lowering the hammer the height of lift is varied as the conditions



PIVOT HINGE FOR PILE DRIVER BOOM

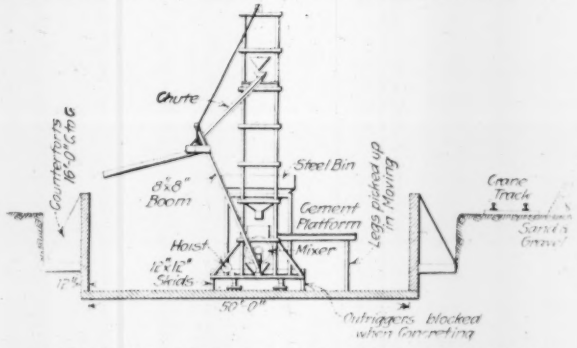
require. A line from the pile driver engine drum operates the boom which is employed largely for handling piles. When piles are to be driven, the boom is lifted from its socket on the hammer and is lashed to the pile driver frame; the shift can be made in a few minutes. The arrangement was devised and is being used by the Harbor Board of San Francisco.

Mobile Tower Chuting Plant

OPERATING at a rate of eighty-one bag batches an hour the tower chuting plant shown by the drawing placed concrete in the floors and walls of coal bins being constructed for the Amalgamated Sugar Co., of Ogden, Utah, at the rate of 155 cu.yd. in nine hours. Three bins were constructed at Ogden and at Lewiston, Utah, and at Paul, Idaho. They averaged 700 ft. in length were 50 ft. and one was 46 ft. wide and the volume of concrete was about 7,500 cu.yd.

The plant consists of a 40-ft. self-supporting t a ½-cu.yd. Smith tilting mixer, a 10-cu.yd. steel hopper, a cement platform and a steam hoisting en all mounted on 12 x 12-in. skids. A 38-ft. boom self-supporting chute 30 ft. long permitted concrete tribution to the walls abreast of the plant and t floor 100 ft. ahead, it being necessary to use chutes on horses when running the floor The me ing hopper was mounted on the cement platform.

In operation, a locomotive crane supplied the gr hopper and the cement platform. Two men on cement platform prepared the batches which were sack each. The floor was first poured, then the walls, after which the plant was moved ahead by pow from the hoisting engine. The average time requir for each move was 15 min. Each day's run involv 155 cu.yd. By maintaining a speed of eighty batche per hour this was completed in an average time o eight hours. A nine-hour day was being worked an on only a few occasions was it necessary to work over-



TRAVELING TOWER PLANT CONSTRUCTS LONG CONCRETE BINS

time to move the plant and make the day's run. A crew of ten men was used, including the crane operator.

The cost of erection of this plant was small as compared with a central mixer plant and a spouting system. The cost of mixing and placing was only 66c. per yard including the cost of fuel and the cost of the plant.

The work was conducted under the supervision of B. F. Dinsmore for the contractors, C. F. Dinsmore & Co. of Ogden, Utah.

Pennsylvania Townships Raise Large Road Sum

During the years 1917, 1918, and 1919, second-class townships of Pennsylvania counties collected $26,551,297.67 for road purposes, says a recent bulletin issued by the Pennsylvania State Highway Department. Under the law township supervisors fix a tax rate for road purposes, moneys thus collected to be spent for the upkeep, repair or reconstruction of township roads. In 1917 the total sum collected was $6,122,812.79; in 1918, $8,972,190.67, and in 1919, $11,456,294.21. The townships of Cameron County were low for the state at large in 1919, collecting only $15,219.89; while Fayette County townships were high, the total sum collected being $1,010,351.37. Under an act of the 1919 legislature, townships of the second class are rewarded for work actually accomplished, and $1,000,000 is being distributed to townships which have qualified under the terms of the act.

NEWS OF THE WEEK

New York, August 12, 1920

Air Mapping Tested at Washington

To prove further the reliability and the utility of maps made from the air, representatives of the Rand-McNally Co., in co-operation with the Army Air Service, are making detailed maps of the immediate vicinity of Washington. On the success of this venture will depend certain projected larger ventures in map making from the air.

Tunnel Progress on Hetch Hetchy Totals 3 Miles

More than 3 mi. of tunnel have been excavated on the Mountain Division of the Hetch Hetchy Aqueduct, according to a statement issued recently by the City Engineer's office. The Construction Company of North America, which began operations on May 17, has excavated almost half a mile of tunnel since taking over the city's forces.

Two tunnel contractors have applied to the construction company for subcontracts on this work. One of these contractors proposes to excavate the portion of the tunnel between Casabaum Adit and Priest's at a cost of $45 per lineal foot, exclusive of concrete tunnel lining. The bid of the Construction Company of North America for this work, including the lining, is $81.58 per lineal foot.

The City Engineer estimates that the lining will cost $25 per lineal foot, so that the offer is regarded as advantageous from the city's standpoint. The other sub-contractor offers to sub-contract the work on the enlarged section of the tunnel from Casabaum to Early Intake at a cost of $55 per lineal foot complete. The bid of the Construction Company of North America on this portion is $66.87 per lineal foot.

The following is the progress to date at each of the tunnel headings where work is being carried on: Priest Portal, 6,320 lin.ft.; Big Creek, west heading, 1,400 lin.ft.; Big Creek, east heading, 1,000 lin.ft.; South Fork, 4,280 lin.ft.; Early Intake, 4,000 lin.ft.

If the suit to restrain the Construction Company of North America from carrying out its contract were set aside, instead of work being carried on from five headings and with two shifts in each heading, as at present, the number of working faces can be tripled, three shifts put on in each face, and the entire 18-mile tunnel aqueduct finished within two years.

On the Hetch Hetchy Dam the Utah Construction Company has the stripping of the abutments practically completed and is working on the deep foundations.

Contracts are in process of preparation for the Moccasin Creek power house, which will cost approximately $4,000,000 and for the Priest Dam to cost $1,000,000. It is expected that bids for these structures will be called for within three months.

General Connor Named Chief of Waterway Division

Brig. Gen. William D. Connor will succeed Brig. Gen. Frank T. Hines as chief of the Inland Waterway Division of the War Department. General Connor is particularly familiar with Mississippi River conditions. During the World War General Connor held a number of positions of great responsibility in the A. E. F. in France, having been chief of staff, Headquarters, Services of Supply, under General Harbord, and, after General Pershing's return to the United States, commanding general of the American forces in France.

BRIG. GEN. W. D. CONNOR

Highway Engineering Scholarship at University of Texas

A scholarship in the University of Texas, with an annual income of $300, to be awarded every year by the faculty of the civil engineering school to a student specializing in highway engineering, has been created by J. G. Culbertson, a manufacturer of automobile trucks, Wichita Falls, Tex.

Engineering Societies Invited To Join Federation

November has been fixed as the time for the first meeting of the American Engineering Council, representing the Federated American Engineering Societies, and last week there was mailed to national, state and local organizations an invitation to join the federation and to name delegates for the organizing session in the fall. The communication, as issued by the Joint Conference Committee of the four national societies of civil, electrical, mechanical and mining engineers, is reprinted in full below:

"The Joint Conference Committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as the Ad Interim Committee in accordance with the authorization of the Organizing Conference held in Washington, D. C., June 3-4, 1920, extends to your organization a cordial invitation to become a charter member of the Federated American Engineering Societies and to appoint delegates to the first meeting of the American Engineering Council, of which due notice will be given, to be held in the fall of this year.

"There has been previously sent to you an abstract of the minutes of the Organizing Conference, at which there were in attendance 140 delegates, representing 71 engineering and allied technical organizations. It was the unanimous opinion of the conference that there should be an organization—

> 'to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical professions,'

and that this organization should consist of societies or affiliations, and not of individual members.

"On the basis of these fundamentals the attached constitution and by-laws were unanimously adopted by the conference. These contain full information concerning the Federated American Engineering Societies, the American Engineering Council, its executive board, and of the various officers and committees. The basis of representation therein stated for the American Engineering Council is one representative for from 100 to 1,000 members and an additional representative for each 1,000 members or major fraction thereof.

"At the gathering in Washington, which was the greatest event in the history of the engineering and allied technical organizations in this country, steps were taken which created 'The Federated American Engineering Societies,' which will have a far-reaching influence on the future of these professions. The fact that this action was taken without a dissenting vote indicates that the psychological moment had arrived and that there was a unanimous desire on the part of the representatives of these professions for the organization formed.

"The Joint Conference Committee, the Ad Interim Committee, would ask each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year.

"The Joint Conference Committee is confident that with the universally acknowledged need for such an organization there will be a prompt affirmative response to this invitation."

Road Districts Avoid Construction Tieup by Open-Top Car Purchase

When the car shortage threatened to tie up construction on the Crittenden County, Ark., $3,000,000 road paving projects, where 50 mi. of concrete and 115 mi. of gravel roads are being built, the district road commissioners purchased outright for cash 105 open top automatic dump steel railroad cars of 80,000 lb. capacity from the Western Wheeled Scraper Co., paying approximately $300,000 for the equipment. About 70 of the cars have been delivered and the remainder of the order is expected to arrive by Aug. 15.

Arrangements have been made with the Frisco R.R. to handle the cars between gravel pits in southern Missouri and Arkansas in three solid trains, delivering one train load of gravel a day. Elevated spur tracks long enough to unload an entire train at one time have been put in at Clarkdale, Gillmore, James Mill, Dewey Mill and Marked Tree, Ark. When all the road building materials required at these points are delivered the tracks will be moved to other points convenient to the work as it progresses. The road districts own ten unloading cranes which will be used to move the gravel from the side of the track to storage piles, whence a fleet of 40 motor trucks will convey it to the works.

Instead of letting the paving by contract, the road commissioners are doing the work, with the Morgan Construction Co., of Memphis, engineers for the districts, in charge. The four districts in which the work is being done have invested about $5,000,000 in railroad and construction equipment. It is all new, high-grade equipment, which it is believed can be disposed of when the work is done, at little or no loss.

Professional Meetings of Canadian Engineers at Niagara Falls and Banff

The Ontario general professional meeting of the Engineering Institute of Canada is to be held at Niagara Falls, Ont., Sept. 16, 17 and 18. The full program has not yet been announced, but it will include a number of papers on the new Chippawa-Queenston development of the Hydro-Electric Power Commission of Ontario around Niagara Falls and the Welland ship canal, as well as visits to the construction operations on both of these works. The meeting will open Thursday noon with a luncheon and will continue through Saturday noon. The sessions will be held at the Clifton, which overlooks the Falls on the Canadian side.

The Western professional meeting will be held at Banff, Aug. 14-19, as has been noted in these pages before. Papers will be delivered on concrete in alkali soils, on Vancouver harbor work and on legislation affecting engineers.

Engineers Will Study Municipal Problems

The National Executive Committee of the American Association of Engineers will appoint twelve of the leading professional engineers to study the problems of civic administration of public works and report their findings to all chapters as a guide to local engineers in the exercise of their duties as citizens and engineers.

Oregon Grants 41 Engineer Licenses

Forty-one applicants were granted licenses to practice professional engineering in Oregon at the meeting of the State Board of Engineering Examiners in Portland July 9. This action brings the total number of licensed engineers in Oregon to 1,161, of which 110 are not residents of the state.

As some of the engineers are qualified to practice more than one branch of the profession they have been granted certificates in each of the branches in which they were found proficient. The following table gives the classifications on the certificates as granted:

Civil engineering	805
Mechanical engineering	178
Hydraulic engineering	157
Electrical engineering	119
Mining engineering	64
Metallurgical engineering	50
Structural engineering	36
Chemical engineering	14
Logging engineering	12
Naval architectural engineering	11
Fire protection engineering	2

An examination will be held at Baker, Ore., Aug. 6, and another at Medford, Ore., Aug. 27.

The members of the State Board of Engineering Examiners are: President, O. Laurgaard; vice-president, F. D. Weber; G. A. Covell, John H. Lewis, Frank S. Baillie, W. B. Dennis, R. R. Bartlett, Fred Hesse, E. G. Hopson.

Indiana Plans Extensive 192 Road Program

A 1921 state highway program to c between $26,000,000 and $30,000,000 contemplated by the Indiana Highw Commission, according to Lorenzo H. Wright, director of the commissi The sum will provide for the paving approximately 500 mi. of roads, t building of bridges, for the main tenance of approximately 2,500 mi. o roads in the state highway system an for meeting the overhead expense o the department. This year the depar ment has under construction 315 mi. o hard-surface roads.

The commission's bill now being prepared for the special session of the state legislature to be held shortly will ask for a state highway levy of 30c. on each $100 of assessed valuation in the state. Mr. Wright estimates that on the anticipated $6,000,000,000 state total assessed valuation of this year the levy would produce $18,000,000 revenue for the department. He estimated that to the direct tax would be added $5,000,000, the maximum amount the department may obtain from the federal government for road building next year. From the inheritance tax $500,000 is expected and the automobile license department will add at least $2,500,000, according to present estimates.

The total thus available for the department next year would be $26,000,000. This may be increased $2,500,000 by the proposed doubling of the state automobile license fees, but, Mr. Wright said, the state highway commission does not propose to ask the legislature to double the fees, although, he said, such a bill may be introduced at the special session by others.

He estimated that the maintenance department would spend about $3,000,000 or more and that the maintenance and overhead would about consume the combined automobile license receipts and the inheritance tax collections. He figured that this would leave approximately $22,000,000 for road and bridge building.

Dr. Smith Has Longest Term as Director of U. S. G. S.

During the past forty years the U. S. Geological Survey has had but three directors. This period has been almost equally divided among J. W. Powell, C. D. Walcott and George Otis Smith, but on Aug. 14, Dr. Smith exceeded the term of office of Major Powell, who previously had the distinction of having served longer in that position than any of the other directors. Dr. Smith will complete his fourteenth consecutive year as the head of the Survey next May. The Geological Survey was created forty-one years ago. Technically speaking it has had four directors, but Clarence King accepted the first directorship only for the purpose of organizing the bureau and served the new organization for but one year in that capacity.

Railroad Equipment Corporation Formed Under Law

Papers were filed in Baltimore July 31 by S. Davies Warfield, president of the National Association of Owners of Railroad Securities, incorporating the National Railway Service Corporation under the laws of Maryland. The charter gives powers to aid, assist, further and supplement the service of transportation by carriers by railroad subject to Federal regulation; to carry on the business and enterprise of constructing, acquiring by purchase or lease or otherwise, selling, leasing, and otherwise contracting with reference to, maintaining, managing, repairing, disposing of and dealing in locomotives, cars, rolling stock, equipment, appliances, materials and supplies required by carriers by railroad; to receive, administer, invest, lend or otherwise employ or deal with any fund or other assets which may be loaned or made available to the corporation by the Interstate Commerce Commission pursuant to the provisions of the Transportation Act, 1920, as now or hereafter amended, or any other act, or by the United States or by any other party or from any source; to act as an agency of the Interstate Commerce Commission in the matter of loans for the purchase of equipment and to assist or serve the said commission in any other capacity or way now or hereafter authorized by law.

CORPORATION'S POWER

The corporation shall have power to act as an agency of the President of the United States in the discharge of any functions relating to Federal control or the relinquishment of all liquidation thereof which may be authorized by the President in conformity with law.

In connection with the incorporation, Mr. Warfield made a statement, which, in part, follows:

"The organization of the National Railway Service Corporation completes as far as is now practicable the plan for the return and regulation of the railroads presented to the Interstate Commerce Committees of Congress in January, 1919, by the National Association of Owners of Railroad Securities. Two of the three fundamental features initiated by the association in that plan are now essential features of the present Transportation Act. One is the mandatory provision that rates are to be made to yield the fixed percentage return named in the act upon railroad property in the aggregate and essential to preserve the transportation system and continue it under private ownership and operation. The second is a division of earnings of a railroad where rates yield to it more than six per cent on its individual property, one half to be retained by such road; the other half establishes a public fund to be expended by the Interstate Commerce Commission for transportation needs.

"The third fundamental of the plan provided for the organization of a national public corporation designed among other things to finance equipment to be leased or otherwise acquired by railroads. We thought we could foresee the necessity for providing the means to relieve the congestion bound to occur upon the return of the roads to their owners and now taking place.

"To accomplish as far as now practicable what was then intended, we are now organizing the public corporation to be called the National Railway Service Corporation, authority for which was obtained under an amendment to the Transportation Act added to the Sundry Civil Appropriation Bill and suggested by our association when that bill was in conference between the two houses of Congress. This amendment was adopted by the conferees and passed by Congress in the closing hours of the last session.

"Accordingly, the Interstate Commerce Commission has recognized the National Railway Service Corporation as an agency to which it will make loans under this amendment and to enable that corporation to provide additional funds to finance much needed equipment for the railroads."

Michigan To Give Graduate Short Courses in Highway Subjects

Graduate short courses in highway engineering and highway transport are to be given at the University of Michigan, Ann Arbor, beginning Dec. 8, 1920. The courses, which will be given by the various civil engineering professors, will be concluded March 25, 1921. Dates on which these short courses are to be given and the subjects included are given herewith:

Dec. 8 to 21: Highway Engineering Theory, Design and Economics. Grading Machinery and Operations.

Dec. 27, 1920 to Jan. 7, 1921: Highway Transport Surveys. Highway Specifications, Contracts, and Jurisprudence.

Jan. 10 to 21: Earth, Sand-Clay, Gravel and Broken Stone Roads. American and English Highway Transport Methods.

Jan. 24 to Feb. 4: Bituminous Surfaces and Bituminous Pavements. Bituminous Materials. Interrelationship of Highway, Railway and Waterway Transport.

Feb. 7 to 18: Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers. Highway Laboratory Research. Highway Structures. American and English Highway Traffic Legislation and Regulations.

Feb. 21 to 25: Seventh Annual Michigan Conference on Highway Engineering.

Feb. 28 to March 11: Brick, Cement-Concrete, Stone Block and Wood Block Pavements. Highway Engineering Seminar. Highway Transport Management, Costs and Record Systems.

March 14 to 25: Highway Engineering Financing, Administration, and Organizations. Highway Transport Seminar.

Notes from Corps of Engineers

Brig.-Gen. Amos A. Fries and Major Earl J. Atkisson have been formally released from the Corps of Engineers, U. S. Army, to become officers in the Chemical Warfare Service. These officers were associated with the Chemical Warfare Service since early in the war, but until now they have retained their status with the Corps of Engineers.

The examinations under the Army Reorganization bill for commissions in the various staff corps of the Army have been completed and all the papers have been forwarded to Washington, where their examination by special board has been begun. The Corps of Engineers, in particular, is suffering from a shortage of officers, but no forecast is ventured as to when the results of the examination will be announced.

Col. Mason M. Patrick, Lt.-Col. Gilbert A. Youngberg and Major F. B. Wilby form the committee on organization of engineer troops. The committee is acting in an advisory capacity to the committee of the General Staff, which has the entire organization of the Army in hand.

Law Would Give Road Contractors Partial Payments Each Mile

A measure that will authorize the director of the Indiana State Highway Commission to allow the contractor 90 per cent of the estimated cost of a mile of road when the mile is completed recently was passed by the senate of the Indiana legislature during a special session. Estimates on completed portions of the road are to be provided by the chief engineer of the state highway commission. The bill is expected to pass the lower house. It was brought up because of a general tightening of credit which made it almost impossible for road contractors to finance contracts.

Development of Oklahoma Asphalt Deposits Undertaken

Considerable development work upon the holdings of the Continental Asphalt & Petroleum Co. in southern Oklahoma is being undertaken by the E. W. Foley Contracting Corp. of New York City. The company's holdings, located in the heart of the Arbuckle Mountains, contain approximately 30,000,000 tons of natural rock asphalt, according to company estimates.

The company is building a railroad connecting the mines with the main line of the Santa Fe Railroad, and it is installing a modern asphalt crushing plant, together with a refinery and asphalt brick plant. It is estimated that the work will necessitate an expenditure of approximately $1,000,000.

Conferences on Water Power Law Enforcement

Conferences are scheduled to be held in Washington Aug. 12 and 13 at which the draft of portions of the regulations to be promulgated in connection with the Waterpower Act will be discussed. A committee of the National Electric Light Association, as well as representatives of various private interests, will attend the conference of Aug. 12.

The regulations dealing with the financial features of the law will be discussed on Aug. 13. A number of large bond companies and banks have signified their intention of sending representatives.

A hearing has been scheduled for Aug. 24 at which officials of the Federal Power Commission will discuss the Great Falls project with the Public Utilities Commissioners of Virginia and of Maryland and the Commissioners of the District of Columbia. Each of the railroads entering Washington has been asked to send representatives to this hearing. The large consumers of power in Washington and throughout the Great Falls area also are to have representatives in attendance.

Hydro-Electric Commission Organized in New Brunswick

A government commission to control water power in the Province of New Brunswick, Canada, similar to the Ontario body, has been organized under the name of the New Brunswick Hydro-Electric Commission. C. O. Foss of St. John has been elected chief engineer of the commission. According to preliminary statements the commission has adopted the policy of proceeding with the development of three water powers—the Shogmoc for St. John Valley, the Letreaux for St. John, and the Tetagouche for the north shore.

City's Engineering Service Threatened, Says Chicago Society

Resolutions passed by the Chicago chapter of the American Association of Engineers charge that the morale of the city's engineering bureaus is threatened with destruction as a result of the dismissal of T. G. Pihlfeldt and H. E. Young, bridge engineers, on the part of the civil service commission two months ago. The chapter calls upon Mayor Thompson to remove from office the three civil service commissioners and C. R. Francis, Commissioner of Public Works.

Examination of the evidence by a committee of engineers having shown the discharge of the two bridge engineers to be unwarranted, the resolution declares that their trial by the commission was a farce and an exhibition of spoils politics. It also urges all members of the engineering profession to refrain from entering the city's service under the present conditions.

Philadelphia Appropriates Money for Bridge Preliminaries

Following a meeting of the joint New Jersey and Pennsylvania interstate bridge commissions two weeks ago, when Mayor Moore of Philadelphia stated that the city's contribution of $250,000 toward the expenses of preliminary study for a Delaware River bridge had not been legally authorized, the city council has enacted an ordinance appropriating the required sum for the bridge investigation. With this action the appropriations of the Pennsylvania and New Jersey state legislatures for the work become available. It is expected that definite organization for the engineering preliminaries will be created by the joint commissions in the near future.

Detroit to Vote on Bond Issue of $37,000,000

Bond issues totalling $37,000,000 will be passed upon by the voters of the city of Detroit on Aug. 31 to provide for waterworks and sewer extensions.

Construction of the proposed new filtration plant and extensions to the city's water system will be financed from a $12,000,000 public utility bond issue, if passed. Of this sum $5,000,000 is to be used for the construction of a filtration plant and the remainder of the $12,000,000 is to be spread over water extensions for the coming five-year period. Plans for the filtration plant have been in preparation for some time, experiments have been conducted and items have been included in the water board budget from time to time looking toward the construction of the plant for which the bond issue will make the money available immediately.

The $25,000,000 issue to be voted for sewers will enable the city to proceed as rapidly as possible with sewer construction, without being held back each year by the 2 per cent limitation placed on the total budget.

The basis of the bond issue is made up from the following program:

Linwood system extension	$150,000
Six Mile Road—Conant to Linwood	1,759,000
Third Street extension	900,000
Michigan Ave	80,000
Small arms	1,200,000
Livernois	1,500,000
Connor's Creek project	13,000,000
Additional Bates Street	2,100,000
Joy Road extension	1,160,000
Six Mile Road—Linwood to Livernois	611,000
Seven Mile Road	2,200,000
Snyder Road	2,000,000
Connor's Creek interceptors	1,035,000
Total	$27,695,000

The Connor's Creek drain will care for the north and northeast sections of the city and the Bates Street project will take care of sewage in the central part of the city as far north as Highland Park.

It is expected that the sum asked for will be adequate to carry out the sewer program proposed by C. W. Hubbell, city engineer, and planned to care for a population of 2,500,000.

Decide on Plan for Detroit Grade Crossing Elimination

The plan to be followed in the separation of grades along the Detroit, Grand Haven and Milwaukee tracks, known as the Grand Trunk-Dequindre project, has been decided upon by the Michigan Public Utilities Commission as the plan proposed by the city which provides for a depression of the railway tracks from the Brush Street station to Milwaukee Junction.

The order just issued by the commission states that the separation of the grades of the Detroit, Grand Haven and Milwaukee Railway Co., and intersecting streets along Dequindre Street is necessary for safety and protection of the public, and that the commission approves and adopts the general plan by the city of Detroit whereby the grade of the railway is lowered all along Dequindre Street from Brush Street to Milwaukee Junction and the streets are to pass over and above the railroad tracks. By this decision a controversy has been settled which has been under discussion since 1913.

The city will now endeavor to arrange with the company as to which sections will be taken up first so that a program will be decided upon and detailed plans worked out immediately. The City Plan Commission has also been consulted with a view to having determined beforehand what streets are to be widened. In event a street is to be widened at a later date provision will be made for the widening at the grade separation crossing by planning a bridge to correspond with the increased width when the bridges are being designed for the grade separation project.

Questions yet to be decided by the commission are date of beginning; apportionment of cost between the city and the company; abuttal damages and their distribution; streets to be closed during the progress of construction work.

The work for the city of Detroit is being directed by John Reid, engineer, Department of Grade Separations.

Ontario to Go Slow on Purchase of Interurban Railways

Premier Drury, of Ontario, has issued a statement defining the policy of the Provincial government in regard to the proposed purchase and construction of hydro-electric radial railways by the Hydro-Electric Power Commission under government guaranties. The commission, in addition to work already inaugurated involving commitments of several million dollars, against which the municipalities interested have issued debentures to an amount approximating $13,500,000, submitted to the government a proposal for the immediate purchase from the Federal Government of the Toronto Eastern Ry., the Toronto Suburban Ry. and the Niagara, St. Catharines & Toronto Ry. at a total cost of $6,873,374. The Gov-

ernment has decided that the proposals of the commission cannot be adopted until the whole subject has been fully and exhaustively examined, the matter being of too great importance to be dealt with hastily. The Government has therefore appointed a commission to study the problem and to hold public hearings. The statement concludes as follows, "In the meantime all action in the direction of further outlays or the assumption of further responsibilities in radial matters by the Hydro-Electric Commission will be stayed."

The principal considerations actuating the government in calling a halt to the projects of the Hydro-Electric Commission are of a financial character. To date it is pointed out the province has advanced approximately $56,750,000 to the Hydro-Electric Commission and in connection with the Central Ontario system. It has also guaranteed bonds bringing its obligations to practically $65,000,000, or 52% of the provincial debt. In addition the province will have to supply in the near future over $32,000,000 in cash to complete the Chippawa, Nipigon and other power works now in process of construction, and in other ways the province is already committed to Hydro expenditures totaling nearly $40,000,000. In all the government estimates the aggregate Hydro expenditures at $104,000,000.

Railroad Construction Budgets Reported Increased

It has been made known that the assurance of improved credit of the railroads, following the announcement of the Interstate Commerce Commission of an increase of from 25 to 40 per cent in rates, has led railroad managements to plan on increases in budgets for construction up to 20 per cent more than amounts previously indicated in reports by 106 railroads made to the commission last April. It is thought also that large increases in maintenance items will be quite general. Out of the 171 class 1 roads, 249 class 2, and 1,000 class 3 roads, the report of last April to the Interstate Commerce Commission included only 106 companies (among which, however, are some of the largest trunk lines in the country) and indicated an item of over $282,000,000 in the 1920 budgets for additions and betterments exclusive of equipment. This item increased by about 20 per cent would become almost $350,000,000, representing only the 106 roads in question.

According to the report made to the commission, the item included the following:

	United States 106 Roads
Additional main tracks	$22,165,000
Additional yard tracks and sidings	41,149,000
Signals and interlocking plants	6,549,000
Shops	43,273,000
Stations and station facilities	15,136,000
Extensions and branches	5,906,000
All other road improvements	148,370,000
Total	$282,548,000

Some of the larger projects are: Double tracking on the Virginian Ry., further extension of the Cedar Hill yards of the New Haven, the Pennsylvania's extension to Detroit, and enlargement of the Detroit terminal of the Ann Arbor R.R., tunnel elimination work on the Delaware & Hudson, line revision and increased trackage of the Evansville, Indianapolis & Terre Haute, new grain and coal piers of the Western Maryland and Pennsylvania in Baltimore, enlargement of terminals at Fort Worth, Tex., line revision on the Norfolk Southern, and a cut-off on the Kanawha & Michigan.

Another East River Subway Tunnel Opened to Traffic

On Aug. 1 train service started through the Whitehall St.-Montague St. rapid-transit tunnel under the East River, New York City. The tunnel consists of two cast-iron tubes, the easterly half of the length driven by shield and the westerly half excavated in rock under normal air. It connects on the Manhattan side with the Brooklyn Rapid Transit subway going through Church St., Vesey St., Broadway, Seventh Ave., 59th St., and through the 60th St. tunnel to Queens Borough. On the Brooklyn side it connects with the Fourth Ave. subway line. The opening of the Montague St. connection virtually completes the downtown rapid-transit systems of Manhattan and Brooklyn. Three pairs of tunnels now constitute the Battery group of rapid-transit lines under the East River: the old Battery tunnels (South Ferry to Joraleman St.), the Montague St. tunnels, and the Old Slip-Clark St. tunnels. The first and third are operating parts of the Interborough Rapid Transit Co. system, being the downtown river crossings of the Lexington Ave. or east-side line and the Seventh Ave. or west-side line.

City Planning Commission for Kansas City, Kan.

A city planning commission with advisory powers, consisting of one member from each of seven districts of the city, has been created at Kansas City, Kan. The members serve without pay, but will have a paid secretary.

Civil Service Examinations

United States

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for Form 1312.

Assistant Director of Statistics, $5,000 to $6,000 a year. File application not later than Aug. 31.

Building Estimator, $1,800 to $2,400 a year. File application not later than Sept. 7.

Instrumentman, $5.20 to $8.40 per diem. File application not later than Sept. 7.

Junior Drainage Engineer, $1,200 to $1,920 a year. File application not later than Sept. 22.

Engineering Draftsman, $1,200 to $3,000 a year. File application not later than Sept. 21.

Topographic Draftsman, $1,200 to $3,000 a year. File application not later than Sept. 21.

Canada

Application forms properly filled in must be filed in the office of the Civil Service Commission not later than Aug. 27. Application forms may be obtained from the office of the Employment Service of Canada, or from the Secretary of the Civil Service Commission, Ottawa.

Junior engineers, $1,680 to $2,040 a year.

Statisticians, $2,400 to $3,120 a year.

Senior draftsmen, $1,680 to $2,040 a year.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION. Boston; San Francisco, Sept. 13-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Valparaiso, Ind.; St. Louis, Oct. 10-15.

The Duluth (Minn.) Engineers' Club, at its annual meeting held Aug. 2, elected the following officers: President, W. S. Heald; first vice-president, O. B. Bjorge; second vice-president, Ray S. Huey; secretary, George C. Olmsted; treasurer, A. U. Shipman; directors, A. M. Frazee, Frank Hutchinson, W. J. Mathews, Col. F. A. Pope; representative on the Minnesota Joint Engineering Board, W. H. Woodbury; delegate to Organization Committee of the Minnesota Federation of Engineers, J. L. Pickles.

The North Carolina Society of Engineers will hold its annual convention at Asheville Aug. 12-14. The most important matter to be taken up at the convention will be the state licensing of engineers and surveyors. It is expected that a committee will be appointed to attempt to secure the passage of a bill for that purpose at the next session of the legislature. The first session will be held on the evening of Aug. 12, at which the charter of the Asheville Chapter of the American Association of Engineers will also be delivered. Three sessions will be held Aug. 13, the morning session to be addressed by Charles E. Waddell, consulting engineer, Asheville, who will speak on state licensing of engineers; W. S. Fallis, state highway engineer, and T. H. Gatlin, assistant vice-president of the Southern Railway. In

the afternoon Edwin W. Myers, hydraulic engineer, will talk on the state's water resources. Addresses will also be made by representatives of the Knoxville and Charlotte Chapters of the A.A.E. A business meeting will be held in the evening. Saturday the members and guests will take an excursion to the Pisgah National Forest.

The Southern California Section, Am. Soc. C. E. held a meeting at Los Angeles July 14, at which a number of committee reports were presented. Upon the reading of the report of the Committee on California Engineering Council, it was agreed that action thereon be deferred and that the chairman of the committee be empowered to confer with the Committee of Joint Technical Societies of Los Angeles. The report of the committee appointed to revise the ordinance relative to the signature of a licensed architect required on plans for concrete buildings was heard and adopted. The revised ordinance provided for signature by a licensed architect or recognized qualified engineer. The committee was made a standing committee to consider present building ordinances and recommend such changes as seemed advisable. The report of the Committee on Jurisdictional Awards was then presented, and the chairman was directed to send a copy of it to the board of directors of the parent society and also copies to the other local sections. The report of the Committee on Terminal Investigation received considerable discussion. It was finally accepted, with the insertion of a clause to the effect that the Sachse report was not conclusive nor satisfactory in regard to the freight terminal situation. The board of directors of the section was instructed to send a letter to Mayor Snyder of Los Angeles giving the conclusions of the committee.

PERSONAL NOTES

FRANK SUTTON, of the U. S. Geological Survey, will inspect the topographic work which has been done this year by the Geological Survey in New York, Vermont and Maine.

E. E. MCADAMS, formerly assistant to Dean Nagle of the Engineering Department, A. & M. College of Texas, has been appointed city manager of Bryan, Tex.

W. E. ANDERSON, recently city manager of Brownsville, Tex., has been appointed engineer for the irrigation district at San Benito, Tex. Mr. Anderson was formerly a member of the engineering firm of Maxey & Anderson, of Houston.

HENRY MAETZEL has resigned as city engineer of Columbus, Ohio. His position will not be filled at present, but Robert Simpson, assistant engineer in charge of flood improvement work, will assume charge of the city engineer's office. Mr. Maetzel will become associated with the Rail-Light Co.

C. D. YOUNG, vice-president of the American Society for Testing Materials, has been appointed the representative of that organization on Engineering Council to succeed Albert Ladd Colby. Mr. Young is general supervisor of stores, Pennsylvania System, at Philadelphia.

JULIAN C. SMITH has resigned as general manager of the Shawinigan Water & Power Co. to become vice-president of the new Dominion Engineering Works, Ltd., of Montreal.

THOMAS E. BOND, since 1915 assistant engineer on the International & Great Northern Ry., has been promoted to the position of assistant chief engineer, with headquarters at Palestine, Tex.

MAJOR FRANK P. ADAMS has resigned as city engineer of Chatham, Ont., and has been appointed city engineer of Brantford, Ont., succeeding T. Harry Jones, deceased.

ROMEO MORRISSETTE, until recently with the National Shipbuilding Corporation, Three Rivers, Que., has entered private practice as a consulting engineer in that city. He will give special attention to reports on water powers and timber lands in the St. Maurice district.

DABNEY H. MAURY, of Chicago, has been engaged by the city council of Elgin, Ill., to make a preliminary survey of the local water supply situation.

R. W. BURCHARD, of the U. S. Geological Survey, is completing a survey of the Boulder Canyon Reservoir site on the Colorado River.

WILLIAM B. DAVEY, the newly appointed city engineer of New Orleans, assumed the duties of that office Aug. 1. For the past three years he has been associated with the New Orleans Levee Board, and previous to that for ten years was engaged in looking after the drainage work of the Sewer and Water Board of New Orleans.

LIEUTENANT F. E. WILMOT, civil engineer, of Los Angeles, has been appointed resident engineer for the Republic of Santo Domingo. Previous to the war he had nine years' engineering experience in the Philippine Islands.

DUDLEY ATKINS, JR., formerly engineer of Doniphan County, Kan., has been appointed resident engineer on Federal Aid Project No. 53 in that county, with headquarters at Troy, Kan.

JOHN B. JOHNSON has resigned as bridge designing engineer in the service of the City of Chicago to accept a position as superintendent of bridge construction with the M. & P. Contract Co., Inc., of Rockport, Ind. Mr. Johnson will have charge of the construction of the new concrete arch bridge being built for the State of Illinois across the Kankakee River at Wilmington, Ill.

CHARLES O. LENZ, consulting engineer, New York City, has been appointed one of the consulting engineers for the Foundation Co., of New York City.

A. V. HELMS has been appointed resident engineer on Federal Aid Project No. 41 in Franklin County, with headquarters at Ottawa, Kan.

OBITUARY

CHARLES W. NEWTON, consulting engineer for the Bartlett Hayward Co., of Baltimore, died Aug. 6 in that city. He was born in Boston in 1834 and was a veteran of the Civil War.

DAVID CHAUNCEY SHEPARD, railroad builder and formerly engineer on the Erie Canal, died recently at St. Paul, Minn. Mr. Shepard was engaged on the construction of much of the Great Northern and Canadian Pacific Railroads. He was a member of the American Society of Civil Engineers.

EDWARD H. HOLDEN, assistant engineer, Topographical Bureau, Borough of the Bronx, New York City, died Aug. 7, at sixty-four years of age. He had been connected with the bureau for twenty-seven years and was also consulting engineer to the City of Yonkers, N. Y.

BUSINESS NEWS

THE LEHIGH STRUCTURAL STEEL CO., Allentown, Pa., has established an office in Philadelphia, Pa.

THE EASTON CAR & CONSTRUCTION CO., Easton, Pa., announces the opening of a new office in Chicago to take care of the increasing business in the west and middle-west districts.

THE CONCRETE MIXING & PLACING CO., Chicago, has resumed business on the return from war service of its president, H. B. Kirkland. The company may be addressed at 123 W. Madison St., Chicago.

THE AURORA PUMP & MANUFACTURING CO., of Aurora, Ill., is the name of a new organization which has just completed the erection of an up-to-date factory, equipped with modern machinery, to manufacture a full line of hydraulic pumping machinery. The officers of the company are: President, P. G. Hartz; vice-president, L. W. Bodinson; secretary and treasurer W. L. Todd.